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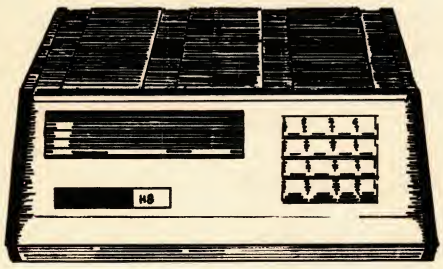
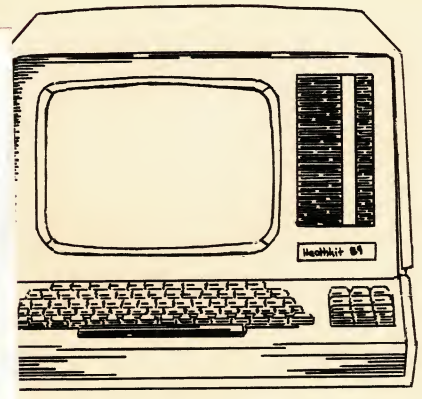
Fall 1982
Issue No. 3

The Independent Magazine for the Entire Zenith Computer Community



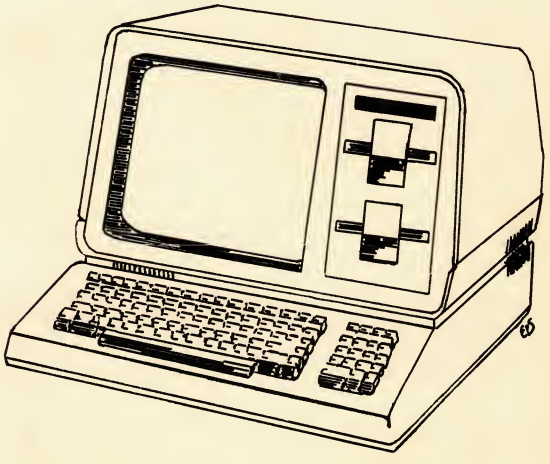
The H8's fifth birthday -
Celebrating with some color graphics

Public domain software for your H11



The world's fastest sort?
Plus six other articles
for '89 users

The Z100 user's manual:
Clear, concise, and useful



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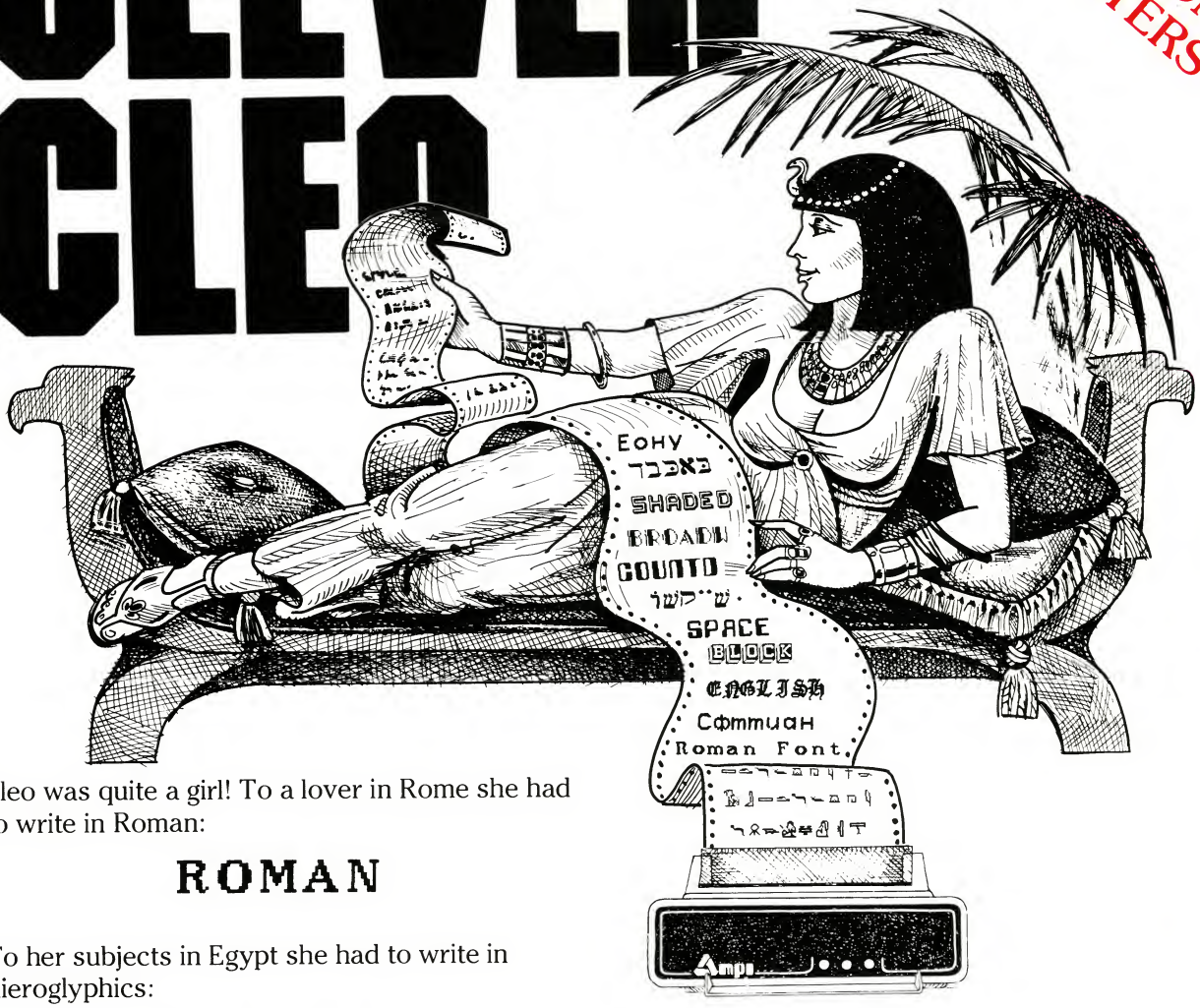
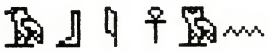


Cleo was quite a girl! To a lover in Rome she had to write in Roman:

ROMAN

To her subjects in Egypt she had to write in hieroglyphics:



And when she wrote to the Israelites, she obviously had to use Hebrew:

דוד רבא

It's a good thing she had an MPI graphics printer available that could handle an unlimited number of print fonts. And it's even more incredible that Cleo's MPI printer was price competitive with the inexpensive printers from overseas. Yes

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CIRCLE #315 ON READER SERVICE CARD

SEXTANT

People buy the H8 for its processing power, not its graphics display capability. But processing power is what makes for better graphics. Take a look at some of the graphics this processing can turn out. **79**

The user's manual for Zenith's new computer line presents a good omen for the future of the Z100. Here's a comprehensive summary of its contents, with a dash of constructive criticism. **71**

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Putting the "O" in "OEM": Magnolia Microsystems
Hal Glatzer 25

Experiment with Artificial Intelligence on your Heath/Zenith Computer
John S. Mays 31
Experiments in artificial intelligence need not be limited to giant mainframes and science fiction. John Krutch has written a book that will show you how to get into artificial intelligence with your own Heath/Zenith microcomputer.

The World's Fastest Sort?
Rick Lutowski 35
Every new sort has to be faster than the last one. But the more data, the slower they get—all of them. The mathematics of the oldest sort of all can change all that. And the revolution starts on Heath/Zenith computers!

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Don Carter 51

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Give Your '89 a Boot—Automatically!
Ray Albrektson 55
You'd like to get the hardware and software that would let your H/Z89 perform all sorts of computer control activities—like turning on the heat in the morning or receiving data late at night. But you'd have to get up to boot it. Right? Nope, your '89 can do it by itself.

Budget Word Processing: A Followup
Hugh Kenner 59
In the premiere issue of *Sextant*, we carried a review of TEXT and PIE word processing software. The judgment: great for the money but with some minor complaints. Now TEXT 4.0 is here and an update is in order.

Double-Precision Trig Functions
Hugh Kenner 62
Herewith, some programming aids for people who aren't into assembly language: five Microsoft BASIC double-precision programs. Sine, cosine, arctangent, tangent, and square root.

Public Domain Software for Your H11
Edward Judge 63
The H11 is Heath's kit form of Digital Equipment Corporation's LSI-11 computer. As a business/scientific computer, most of the well known software offered for it is designed for big budget operations. But a lot of nice stuff is sitting there in the public domain—free (almost).

The Z100 User's Manual: Clear, Concise, and Useful
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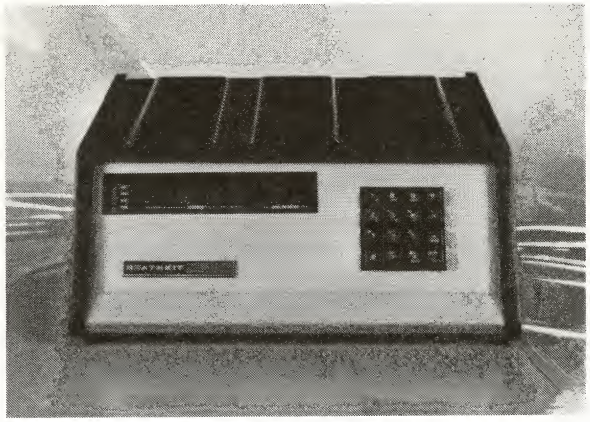

The H8 was the Heath Company's first digital computer. And in the five years since its birth it has seen a lot: some difficulties, yes, but it's scored more than its share of points. In the process, it has educated its users as few other computers could. Here's what you and the H8's developers think about it: past, present, and future.

11

Yes, our business manager did retire rather early! He developed an incomprehensible vocabulary while selecting our new computer system.

The H/Z89 is a personal computer that's made to order for many small businesses. Here's the story of a business man who found he could build it from a kit, put it to work in the office, save money, and have fun in the process.

51

The activity in the retail space, training rooms, and conference center on the upper floor at Magnolia Microsystems is limited to Seattle. But the impact of the hardware and software development performed on the ground floor is felt around the world.

25

Letters

Last time I wrote I was upset because I did not receive *Sextant* until weeks after it was on the shelf at the local Heath store.

This time I've got the upper hand for I'm near first in line. Now I'm not so sure if I should have not waited longer in line. In the past 24 hours I've had to guard the magazine with dear life.

Beautiful issue — great articles — great pictures — expert and highly professional front to back. Last month you taxied and this month you launched greater altitude than the Enterprise. I've read of other persons toying with the idea of a similar magazine — fine — but I'm sure you need not worry — my loyalty is with *Sextant*.

I wish you could have seen the surprised looks at work when they saw *Sextant* — people here in Denver just don't realize how powerful Heath/Zenith is. Now if ZDS will take the giant step forward and flaunt their products more than they have.

Patrick V. McNamara
Englewood, CO

Congratulations on the Premiere issue of *Sextant*. I have been waiting with bated breath for it. Unfortunately, I spent several days in the hospital for treatment of my asthma and did not get a chance to send this sooner. I was especially pleased with the article "Disk Programming *Without* HDOS." I have been wanting to know how for some time; but have not had the time to investigate it myself. Of course, I probably could have gotten this information by buying the disk ROM listing from Heath, but it galls me to have to pay $50 for something they should have put in their manual. The manuals with the ET-3400/ETA-3400 had that kind of information and I would have thought the more expensive H89 might have had it also. A similar problem arose for me when I wanted to install interrupts for my Communication Software Package. Fortunately, I had purchased the excellent monitor replacement ROM (MTRHEX) from Dean Gibson and his documentation provided me with enough information to do it. Perhaps an article on "User Installed Interrupts in the H89" would be worth me doing? I am really glad to see the *Sextant* as I personally get nothing out of *REMark*. I don't have HDOS or CP/M, only UCSD Pascal which I think is terrific. So more general articles like yours are what I hanker for in the Heath line.

Another article which turned out to have special meaning was the one on printer spoolers. Not *just* because of the information on spoolers, but because UCSD Pascal does not support many printers, and the comment on Page 36 about making the MX80 appear as an H14 was useful for one of my fellow USUS members. Maybe he will subscribe to *Sextant* after I told him about this useful bit of information.

I do wish it were to be a monthly, but I guess I will just have to be patient.

Gene Gingerich
Santa Barbara, CA

After reading the article in the Spring '82 issue of *Sextant*, "A Parallel Interface for the '89," I must compliment both J. C. Hassall and *Sextant* for a job well done. Last October I designed a wire wrap board using parts from my cassette interface and an 8255 for parallel interfacing. Being a CP/M user I would like to share the solutions to a couple of problems that would be encountered when attempting to design a PROM programmer using 320-327Q. (Mr. Hassall has made provisions for this on his board.)

When I first built my parallel board, I attempted to connect it to ports 340-347Q as Mr. Hassall suggests for HDOS users. This cannot be done under CP/M, however, as the computer is prevented from booting under Heath's CP/M. After discovering this, I selected ports 320-327Q. After reading in the Intel Data book about the 8255, I proceeded with confidence successfully using BASIC to program and use the 8255. All three parallel ports worked like a charm. However there still was one remaining problem! CP/M, unlike HDOS, initializes its serial ports upon cold boot, causing false initialization of the 8255. That problem was easily corrected by making the CP/M logical device looking at port 320-327Q look at nonexistant ports using DEBUG.

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CIRCLE #354 ON READER SERVICE CARD

The Editorial Eye

Fall has long been my favorite time of year. I grew up in New England, where residents are inclined to think autumn foliage is more spectacular than anywhere else. Since then I've enjoyed this mellow season in Pennsylvania, Georgia, Texas, and Virginia. In 1978, the District of Columbia had more nice days in October than in the previous nine months combined.

(While in the midst of writing this, I received a letter from a former neighbor of mine here on Capitol Hill. She describes her most recent Fall as "incredible. . . warm days, very blue skies, crisp nights." That was in the Kingdom of Lesotho. So autumn can also be delightful in southern Africa.)

Fall is the season which brings the major harvest of new computer products from Heath/Zenith. This year we reap the first major fruit of grafting Heath Company onto Zenith Radio Corporation in 1979. The Z100 series was introduced in the Summer *Sextant;* this time we've taken a look at the user's manual. And included the pricing information which was released after the last issue was printed.

Five years ago Heath Company began shipping its first digital computer kit. So we thought this was a good time to take a look at the origins of the H8, its future prospects, and why it's been the computer of choice for the computer enthusiast. The ability to expand an H8 gradually, in steps which don't make too big a dent in the user's budget, should make it a focus of activity for many years to come.

About a quarter of those who returned a reader service card from the Spring *Sextant* use an H8, while about four-fifths use an H89 or Z89. Yes, several readers have more than one Zenith computer. Relatively few readers told us they have an H88 or H11, but we intend to have something to offer them, also. After all, this *is* the independent magazine for the entire Zenith computer community. We hope to serve *your* particular interests in future issues. We try to cover a good balance of topics within each issue.

We welcome your suggestions for future article topics. It's even nicer if you can tell us something you'd like to write about. If you're interested in writing an article, but don't have a specific topic in mind, we can give you a couple of hints. First, it should be of particular interest to the Zenith computer community. We have no intention of printing articles of general interest. Second, it should be a subject you know something about.

Four articles in the Spring issue were especially popular with our readers. They illustrate several aspects of what we're trying to do with *Sextant*.

"A Professional Writer Looks at Budget Word Processing" is what John Walker and I refer to as an "English-language article." Hugh Kenner's manuscripts have been a delight to work with, in large part because they haven't required much work. The prose has several curve balls, but nothing which assumes a technical background.

Richard E. Smith provided a nice balance with his article on "Disk Programming *Without* HDOS." It was aimed at readers with some experience programming in assembly language. By the way, about 35% more of our readers use HDOS than use CP/M; many use both. We do plan to include articles dealing with CP/M in future issues.

Another very popular article with a heavy dose of technical material was J.C. Hassall's description of "A Parallel Interface for the '89." This

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CIRCLE #336 ON READER SERVICE CARD

was ideal in that it included plenty of information of interest even to those who didn't care to build the board he described.

The fourth article quite popular with readers of the Spring *Sextant* was "Print Spoolers: A Background and Reviews of Six Software Products to Break Your Printer Bottleneck." Kenneth A. Patrick combined descriptions of these products with his own evaluation of them. In the process he sketched the characteristics of an ideal spooler.

The introduction of the Z100 has been greeted by rumblings of discontent from some Z89 owners. They feel that Zenith Data Systems has not done enough for the Z89. Several of them have suggested ZDS should support existing customers rather than seeking new ones. Another complaint is that the Z89 was never promoted aggressively enough. Many Z89 owners argue that the technical superiority of their computers has not been appropriately reflected in the marketplace.

Taking the last point first, I don't think the situation is as bad as it is generally portrayed. Granted, Apple and Tandy are selling more computers than Zenith. Some market analysts think IBM is also doing better. Being third or fourth doesn't sound too bad to me.

Especially when you consider the origins of the Z89. Zenith acquired it with the purchase of Heath Company in 1979. The H89 was designed to be built from a kit, rather than manufactured in a factory. The Z100, on the other hand, has been designed to take advantage of automatic component insertion equipment, and other automated manufacturing methods. The Z100 production line has no need of manual soldering irons.

Zenith has spent the past two and a half years building up the ZDS distribution and support resources. Sales growth has been dramatic. It has been limited more by manufacturing, distribution, and support facilities than by marketing. A less tactful observer than I might say that Zenith Data Systems is finally ready to enter the computer business. It does so with the support of Zenith manufacturing facilities on Taiwan (video displays) and just across the Mexican border (power supplies).

But what about current owners of Heath/Zenith products? Where can they turn for support? They can turn to *Sextant*, and the vendors which advertise in its pages. We've added a score of new advertisers in this issue. Some of their products are available at the retail stores which sell this magazine.

In this issue we have the first in a series of articles spotlighting individual vendors supporting Heath/Zenith products. We will continue to cover independent suppliers in our other articles as well. They have a lot to offer you, and we want you to know about them. Even if their products don't meet your particular needs, we think you should be interested in them as members of your community.

Sextant isn't a hardware magazine, it isn't a software magazine, it isn't an applications magazine, it isn't a games magazine, it isn't a business magazine, it isn't a computer magazine.

Sextant is a community magazine.

And Fall is the community season. The season of going to football games, voting in elections, and returning to school. The season of Thanksgiving. We in the Zenith computer community have a lot to be thankful for. In particular, for the support we can give each other. We at *Sextant* plan on having a lot of fun taking advantage of this opportunity for cooperation. We hope you will too.

Z80 CPU BOARD for the H8*

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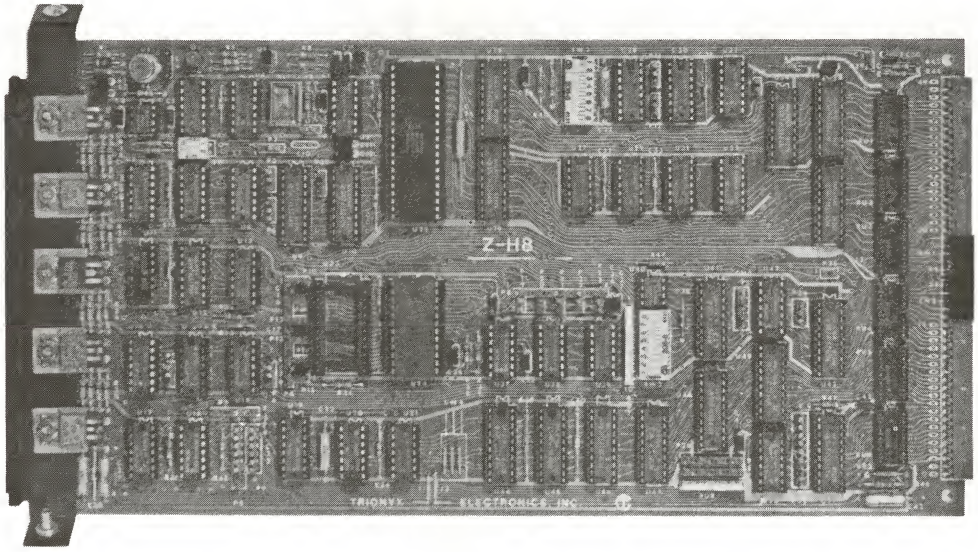

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The H8's Fifth Anniversary: Origins and Outlooks

Frederick Zimmerman

It's time to celebrate! Five years ago this September, the Heath Company shipped its first H8 computer. *Sextant* is happy to join the Heath/Zenith users' community in marking this anniversary. This article is part of our continuing effort to provide support for H8 owners.

In order to find out what you think about the H8, we sent a questionnaire to 110 of you who indicated on your Reader Service Cards that you owned H8s. (Incidentally, this points up the value of returning those cards—they help us provide the articles and information you need.) We received a gratifying number of replies, and we think the replies were informative, despite the skeptical perspective one reader offered: "It has been a week since I filled out this questionnaire, and on rereading it, I could change some of the answers. It goes to show, your answers are governed by your mood."

We included our telephone number in the questionnaire, and posted it on the Capital Heath Users' Group computer bulletin board, so that you could call us directly if you chose. Some valuable and entertaining conversations followed. *Sextant* also interviewed most of the people who designed the H8. Those questionnaires, conversations, and interviews have enabled us to commemorate the H8 with a look at its life and future prospects as seen by you, the H8 owner.

History

Retired Heath president David Nurse told *Sextant* in a telephone interview that "Heath had always been interested in computers," dating back to the 1960s, when Heath carried an analog computer kit. Heath's first steps into microcomputing came in 1974, according to former computer product line manager Louis Frenzel. He told *Sextant* that he and some of his colleagues had begun pushing for a microcomputer project in that year. At first there was an opposing faction composed of Heath people whose work emphasized Heath's traditional consumer products. Their arguments against the project came down to this: "What would you *do* with one?" But this resistance was overwhelmed in late 1974, when MITS introduced its Altair microcomputer, the first true personal computer kit. It received rave reviews in *Popular Electronics*. Heath took notice that the microcomputer industry might be profitable, and began the H8 project soon after.

The H8

What is the H8? It is a kit-assembly computer based on the 8080 microprocessor. Its front panel keyboard allows the user to set up and run the computer without the necessity of a separate terminal. The contents of any address in random access memory (RAM), or the contents of any microprocessor register, can be viewed and changed from the front panel. Heath designed its own 50-line bus to connect the H8 circuit boards, rather than using the Altair bus, also known as the S100, which was soon to become the industry standard. Heath provided an initial supply of software, including a version of BASIC (named after Benton Harbor, Heath's home town), a text editor program, assembly language, and a few rudimentary games. A variety of peripherals and accessories became available, such as additional memory cards, input/output (I/O) interfaces, and the H9 video terminal. Although at first only cassette loading was possible, within a year Heath introduced the WH17 floppy disk system.

"All right, we'll build a computer," said one Heath engineer at the meeting at which the computer product line was launched; "but we're not going to get involved in software!"

The H8 filled an important niche in the personal computer field. And, as Robert Eckert of Bloomington, Indiana, observed, "In that niche, it is the king." It appealed strongly to many Heathkit electronics hobbyists, who were already dedicated

The engineer who was designing the H9 left to work for Atari.

kit builders, and who welcomed the opportunity to move into an exciting new field. Mr. Eckert pointed out the value of Heath's reputation when he noted, "Their lack of compromise in quality and imaginative use of current technologies are only two reasons why I stay with the company year after year."

But our survey showed that customer confidence in Heath's reputation could backfire. Jim Meyers of Las Vegas, Nevada, felt that Heath's support had let him down. "For some reason, I trusted Heath... Heath support has been terrible. Independents have tried but found it difficult because Heath did not fully 'commit' to the H8. It seemed to be an orphan whose parents were still alive." The predominant feeling among our respondents, however, was more similar to that expressed by James Moore of Cambridge, Ohio, who said, "With a 20-year background in electronics service, I appreciate the design and responsibility of the Heath computer products."

Heath/Zenith has also enjoyed a good reputation for its customer service. Many of our respondents cited this as a reason for buying a Heath product. One anonymous reader, however, did not concur. "I have been fighting a bug in my system for over two years. It has been to the local Heathkit store with no satisfactory result on several occasions. I have even called Benton Harbor and spoken to a gentleman who had a hard time speaking English."

Most of our respondents were, as indicated before, satisfied with Heath service; they did, however, wish that Heath's phone lines were busy less frequently. Heath/Zenith officials report that the lines are busy less frequently Tuesday through Thursday. Consequently, if Heath added staff to deal with the Monday and Friday peak loads, personnel might be underutilized during the middle of the week. Heath/Zenith officials state that they are monitoring the situation and would take action if increased demand on Tuesday, Wednesday, and Thursday justified additional full-time staff. Meanwhile, for best results they suggest that you call during the middle of the week, rather than on the peak days of Monday and Friday.

H8 purchasers were able to gain an intimate, "hands-on" knowledge of the hardware of their personal computer. Furthermore, the fact that Heath sells the source listing of its Heath Disk Operating System (HDOS) has allowed H8 owners to become equally familiar with the details of their software. HDOS is the most widely available operating system that lets the user "look inside."

These features account for much of the H8's success in reaching the computer enthusiasts in the marketplace. Our respondents frequently explained their purchase of the H8 by referring to the value of a kit-assembly computer as a way to learn about computers. R. N. Holcomb of Houston, Texas, started from scratch. He told *Sextant*, "Having never turned on a computer, I felt this was an ideal learning project." The optimum result of educational use was described by Steve Howard of Cottage Grove, Minnesota, who said, "The H8 has been the best investment I ever made. It helped me to learn to program, and because of this...I was able to transfer to the programming department at Sperry Univac... Secondly, it has helped me to break into a sideline business of consulting and custom computer programming. Through these experiences, I have been using it to break into the freelance writing market, and have had a ball." Such tales help explain how the H8 reached a market composed largely of technical and professional people with considerable expertise and intelligence.

Design

At the beginning of the H8 development process, Heath thought that the H8 would probably use 16K of memory, and at most 32K. Louis Frenzel told *Sextant* that, at the end of the H8 development cycle, Heath did a survey of computer hobbyists, asking them how much memory they needed, and how much memory they might want to add in the future. The survey respondents "guessed rather low," Mr. Frenzel said. In 1976, no one knew to expect that one might someday use 64K. At the time, memory chips were "horribly expensive," to use Mr. Frenzel's words, and "Heath's main issue from a marketing point of view was to keep costs down." In separate conversations with *Sextant*, hardware engineer Neal Beneditz and software designer J. Gordon Letwin each confirmed that Heath expected the H8 to use 16K, and that they personally thought 16K would be enough. However, circumstances changed, and memory rapidly became less expensive. Heath adjusted its thinking accordingly. Mr. Beneditz said that by the time the first H8s were shipped (September 1977) Heath was

anticipating that H8 users would want as much as 64K of memory.

How did Heath engineers design the H8? Many computer owners have been particularly curious about Heath's decision not to use the S100 bus, which "has become an informal or *de facto* standard in the hobby and personal computing field," to quote issue #1 of *REMark*, the official publication of the Heath Users' Group, which appeared in early 1978. The lead article of that issue presented the company's arguments explaining why its specially designed bus was "lower in cost, cleaner electronically, and easier to interface" than the S100. Neal Beneditz, engineer for the H8, mentioned to *Sextant* in a recent telephone interview that the cabinet had already been styled, and it would have been difficult to fit the S100 bus into those dimensions. But he said, "Cost was the primary concern." Louis Frenzel emphasized the untried, experimental nature of all microcomputer technology when he explained the decision not to go with the S100. "No one had ever heard of the S100! And the early versions of the bus were glitchy." Mr. Frenzel pointed out that Heath has always had to be picky about the quality of its components, because of its generous customer support policies: "If they started getting too many returns, it would put the company out of business."

Tom Yeager, a former Heath engineer who was one of those most intimately involved in the design of the H8, explained the decision to build an in-house bus by saying that "Heath didn't want to encourage suppliers, many of whom were unreliable at that time—that's five years ago, remember—to build weird hardware accessories, then have Heath get blamed when the computer didn't work." It is ironic that eventually Heath "got blamed" for having too *few* hardware accessories. Because Heath did not use the S100 bus, owners couldn't use the many S100-compatible circuit boards available from other computer manufacturers. Heath tried to fill that gap by offering its own circuit boards compatible with the Heath 50-line bus.

One crucial design decision was the choice of the microprocessor, the "brain" of a computer. Some have criticized Heath for using the 8080 instead of the Z80, then a new product from Zilog. There wasn't really much chance to make a decision, because when the Z80 first appeared, Heath had already invested much time and many resources in a development program centered around the 8080. It would have been time-consuming, difficult, and risky to change to a new microprocessor made by a company without an established reputation. Heath wanted to introduce

SOFTWARE for HDOS

SUPER SYSMOD2 —This HODS enhancement program is an expanded version of SYSMOD2 described below. It adds many new features and commands to HDOS which include all the SYSMOD2 capabilities plus the following: alphabetic directory, retaining the original creation date when a file is copied, a DATE switch which selects files created with today's date, a command that copies files that contain hard read errors, SCROLL mode enable, customized system prompt, a free disk space command, a command that searches the disks for a run file, abbreviated commands support 8 unit numbers and 3 drive types (SY:, DK:, DY:) and - best of all - a File Manager command. The powerful File Manager presents the files one at a time on the terminal and gives you a choice of 12 options to perform on the file. For example, just typing DEL will delete it, CO SY2: will copy it to SY2: with the same name, etc. Even the flags can be changed (including the "L" flag). The File Manager is extremely useful for cleaning up a disk full of old files, when backing up a disk or whenever doing a lot of disk housekeeping $29.95

SYSMOD2 — A program that modifies HDOS 2.0 to abbreviate commands (for example, MOUNT SY1: becomes M1, DISMOUNT SY1: becomes D1, and similar for other commands) and adds useful new ones. These include a PRINT (PR) command to replace 'COPY LP: = ', a command to change the label on disks, a DOCOM command similar to SUBMIT in CP/M plus others. SYSMOD2 modifies the operating system by replacing the SYSCMD.SYS file in HDOS. It makes HDOS much easier to use—saves time and effort $17.95

UD.DVD — A truly universal device driver for printers. It will operate with virtually any printer through its settable handshake and format options. Using unit numbers (something like SY0: and SY1: for disk drives), one driver allows you to configure your printer to look like eight printers, each set for different format options. For example, with an H-14 printer, LP0: can be set for 10 CPI with left and right margins set for 10 and 70 characters. LP1: can be set for 12 CPI with different margins, etc. You can even have several printers operating at different baud rates and ports with just one driver. Seventeen options are settable for each of the unit numbers (136 total) and the HELP command will list the setting of each. Requires an H/Z-89 or H-8 with an 8250 UART (H8-4) $29.95

H25.DVD — A driver designed for the H/Z-25 printer which makes extensive use of its features. Has the unit number and HELP capabilities of UD.DVD. In addition, control characters can be inserted in text files to produce subscripts, superscripts and double width, underlined and overprinted characters. $29.95

MX.DVD — A driver designed for the MX-80 family printers that offers settable unit numbers and a status help display similar to that of UD.DVD. Some of the features include use of control characters to implement the more useful escape sequences, selection of desired handshaking mode and polarity, and a transparency mode for full graphics operation. $29.95

BASEDIT — A program that modifies HEATH BASIC to provide a line editing capability within BASIC. Allows you to edit a line rather than retyping to correct errors $15.00

HFORTH-79 — figFORTH Ver 1.1 modified to include the full FORTH-79 standard plus many other features. HFORTH-79 operates under HDOS and makes full use of the HDOS file structure including named files for both program and data I/O. Additional features include a full screen editor with over 20 commands, and 8080 assembler. Requires an H/Z-89 or an H-8 with an H-19 terminal $34.95

HFORTH — figFORTH Ver. 1.1 modified to run under the HDOS file structure allowing named files for program and data I/O. $29.95

DISAS — A fast disassembler program that generates source code suitable as input to the HEATH assembler. $25.00

SPANISH, FRENCH, GERMAN and ITALIAN HANGMAN — Programs to help build a basic vacabulary in a foreign language. $29.95

EDGE — A character oriented text editor based on the public domain editor described in REMARK No. 6. Over one dozen new commands. $25.00

Unless notes otherwise, the above programs will work with the H/Z-89 or the H-8 with 24K RAM minimum. They are available on 5 inch hard-sectored disks at most HEATHKIT stores or directly from SoftShop. Mail orders are sent postpaid in the U.S., First Class mail. Overseas orders add $3.00. Payment must be in U.S. funds only.

HDOS, H-8, H-19, Z-19, H-89 and Z-89 are registered trademarks of HEATH/ZENITH.

Software for HEATH and ZENITH systems

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its new product promptly and on schedule. Furthermore, during Heath's design phase the Z80 had not yet attained its later popularity in the microcomputer industry. Louis Frenzel has a point when he says, "The Z80 didn't exist!" Heath considered the 6800, MOS Technology's 6502, and the Signetics 2650, which Signetics "went all out selling." But the choice eventually boiled down to the 6800 versus the 8080. Many Heath engineers preferred the 6800, because they believed a 6800-based microcomputer would be easier to design. Mr. Frenzel eventually made what he termed an "unpopular" decision because it was necessary to get the design process moving. He thought that "there was more software available for the 8080 than the 6800," an important fact because Heath was concerned that it lacked software expertise. All these considerations entered into Heath's decision to put the 8080 in the H8.

...the cabinet had already been styled, and it would have been difficult to fit the S100 bus into those dimensions.

In 1979, after some users had called for a Z80 central processor unit (CPU) for the H8, *REMark* said that no such product was planned. However, circumstances changed in the marketplace. In July 1981, Heath made available the HA-8-6 Z80 CPU card for the H8, providing owners with a choice of central processor units.

Another important feature of the H8 design was the front panel, which includes a nine-digit LED display and a 16-key keypad. The display allows the user to monitor memory locations directly. In addition, a special key allows the user to run programs one step at a time, which makes the task of debugging software much easier. These functions are useful even when the user has a terminal in addition to the H8. But the front panel is most valuable when the owner does not choose to buy a terminal. The owner can use the H8 front panel as the first step in building up a complete computer system step by step. Presumably, part of Heath's motivation in offering this capability was to keep part of the new computer product line within the price range of as many Heathkit buyers as possible. But it also adds another element of versatility and pleasure for the computer enthusiast.

One of the questions in our survey asked survey recipients to evaluate the merits and flaws of the H8's design. One flaw which several readers saw in the computer's design was the fact that the H8 has no fan. R. N. Holcomb of Houston remarked that "it should have had a fan without the owner having to 'cut and paste'." Robert Eckert of Bloomington added his own experience: "With 56K and I/O cards it nearly fries." Ironically, Mr. Eckert's words are a backhanded compliment to Heath, because the inside of the H8 was originally intended to carry at most 32K. Heath can't be criticized very severely for failing to realize that the H8 was so versatile that H8 owners would load their computers with every memory board and I/O card in sight. Heath built such a good compact that its owners treat it as if it were a Cadillac! Of course, this doesn't help owners who still have a problem; but some owners have installed fans themselves, and if care and foresight are used, this may be a satisfactory solution.

Several H8 owners also cited the use of tin-plated bus pins as a serious design flaw. James S. Neiman of Reading, Pennsylvania, expressed his displeasure as follows: "Cheap inadequate horrid rotten damnable connector pins used in both the H8 and the H9 are a continual pain.... They are extremely susceptible to a corrosive action which can cause a multitude of failure modes, and usually does when the system is needed in a hurry for some important task." Jim Meyers shared Mr. Neiman's anger at the "awful bus connectors," and was also offended by "the strange mixture of sockets and pins [which] dangle out of it...." James Moore of Cambridge, Ohio, had similar problems with his connectors, and mentioned that "I had to take out all the boards a couple of times and clean the motherboard pins off with a wire-brush solder tool." Heath later substituted gold-plated connector pins which performed much more reliably.

Hardware

Hardware support has developed considerably since the introduction of the H8. At first, only a cassette tape loader, the H8-5, and a paper tape punch/reader, the H10, were available, although Heath announced a floppy disk system, the WH17, in March 1978. The first fully assembled models, the WH17s, were shipped in June 1978. The kit-form H17s began to be shipped about six months later. Originally, Heath offered support which was sometimes unexciting—memory boards in flavors of 4K, 8K, and 16K—and sometimes disappointing—the H9 video terminal. But five years later, the Heath catalog had a more varied range of accessories: a music synthesizer system; a reusable circuit design breadboard card; a new video terminal, the H19, with optional anti-glare CRT; a speech synthesizer; the HA-8-3 Color Graphics Board; and several different kinds of printers. Heath's new products were matched by the activity of the independent suppliers, who began to produce items to enhance the H8, such as color video boards, memory boards, and prototype boards. Tom Yeager, former Heath H8 design

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Teaches state recognition from graphic maps, capitols, nicknames, flowers, birds, trees and largest cities. An excellent geography learning aid. *DUALFORMAT* **$24.95**

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FIREMAN is a video action game which requires a good eye and quick reflexes while still being simple enough for the youngsters to enjoy.

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S-Basic translates a structured BASIC program into B.H. BASIC or Microsoft BASIC. It makes basic programming more enjoyable, efficient and reliable.

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A Data Entry/Base Language compiler. Supports data input editing and Random data retreival and update. Write business applications in a fraction of the time. *HDOS* **$99.95**

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Modifies HDOS to permit a "2nd" device to duplicate the I/O of your console terminal. Eleven functions give added control and security.

HDOS **$39.95**

MAGIC MENU

Converts any system to turn-key operation. Menu calls BASIC/ABS/ or any other program from command mode, and all programs automatically return to menu. Even executes multiple command strings. Menu headings are user defined.

HDOS **$29.95**

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5 utilities (CP/M, only the first 2) Search And Print, MSMAP, PHLAGS, DIRSORT, HMOD2.

HDOS or CP/M **$19.95**

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Sorts any disk file (external) regardless of size. Select FIXED, VARIABLE, OR MULTIPLE RECORD records. *HDOS* **$29.95**

USER

is a modification to HDOS that will support Dynamic Disk Partitioning. This function is similar in nature to the USER function supported CP/M. With 8 User Areas you can define a file to be resident in any/some/all of the Areas.

HDOS **$29.95**

UTILITIES

Nine (9) data manipulation utilities for HDOS includes BACKUP/RESTORE, TAB/UNTAB, CAPITAL/UNCAP, COMPARE, SEARCH AND SP.DVD. *HDOS* **$34.95**

DATA MANAGEMENT

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Prints Labels, Letters or Lists. Merge Label data into your letters. A host of user definable options. Map driven output lets you determine output formats. *HDOS or CP/M* **$39.95**

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Single drive Name/Address/Phone manager. Operates in turn-key fashion. No experience necessary. *HDOS/MBASIC* **$19.95**

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Ordering Instructions:

Sunflower Software can be seen and/or purchased at your nearest Heathkit Electronics Center. When ordering direct, include $2.00 for postage and handling. Kansas residents include 4% sales tax. Specify operating system when applicable.

Attention Programmers:

Sunflower Software is interested in high quality software for the H8/H89. Let us evaluate your original programs for our internationally marketed line.

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engineer, said to *Sextant*, "We should have worked more closely with some of the more reliable independent suppliers out there. We didn't have the manpower to provide a whole host of accessories, games and stuff the computer hobbyists would have enjoyed."

Some serious problems with hardware support did emerge in the early days of the H8. For example, the notorious H10 paper tape reader/punch proved to be poorly designed and prone to frequent mechanical breakdown. This was primarily a problem for users of Heath's model H11 computer, who had no alternative to the H10, but it also inconvenienced H8 owners and damaged the reputation of all Heath products. Many unhappy users wrote to *Buss: The Independent Newsletter of Heath Company Computers*. One irate user, Richard Sims, said in *Buss* #7, February 1978: "I write to express my complete dissatisfaction with the H10 ... Heathkit's miserable excuse for a paper tape reader/punch is completely unreliable ... by reason of inept mechanical engineering." Heath later produced a modification kit which apparently improved the performance of the H10. But by that time most H8 and H11 users had concluded, as Robert Enns put it in another letter to *Buss* (issue #9, July 1978), that the H10 was "a horror show of a machine." Ironically, reported Mr. Frenzel, it sold well.

In separate conversations with* Sextant, *hardware engineer Neal Beneditz and software designer J. Gordon Letwin each confirmed that Heath expected the H8 to use 16K, and that they personally had thought 16K would be enough.

Some H8 owners were unhappy with the H9 video terminal, also known as "the H9 boat anchor." It suffered from a bad case of key bounce, making it a touch typist's nightmare. The display had an annoying tendency to flicker. Only uppercase characters were available. And the H9 was technically more difficult to assemble than most Heathkit computer products, increasing the number of malfunctions caused by improper assembly. This was a special frustration to owners, since such malfunctions were not covered by warranty.

We asked Louis Frenzel about the H9 in our recent interview. He told *Sextant* that, in the middle of the project, the original design engineer quit and went to California to work for Atari, which had recently introduced the revolutionary video game "Pong." The best thing to have done would have been to start the design all over again, from scratch; but there wasn't enough time. As a result, Karl Goy, the engineer who took over, was left with a difficult situation. Mr. Frenzel now acknowledges that the H9 was "compromised." Some Heath employees privately admitted the terminal's shortcomings. One said to *Buss*, issue #10(September 1978), that "I can't make it go away; I would if I could." Jim Meyers of Las Vegas, one of our survey respondents, asked us, "Why didn't Heath ever even try to manufacture an upgrade kit for this machine? A 12- to 24-line upgrade would have been helpful considering how much many of us paid for the soon-to-die H9." Heath's ultimate response to the difficulties with the H9 was to introduce the superior, and vastly more popular, H19 video terminal.

Software

"All right, we'll build a computer," said one Heath engineer at the meeting at which the computer product line was launched; "but we're not going to get involved in software!" When Heath began designing the H8, it knew that the company's greatest weakness in the microcomputer industry was its limited in-house software expertise. Louis Frenzel said, "There was basically no one in Heath who could program interpreters, editors, or assemblers. There were only a few

CP/M USERS WANT THESE

89/STAR: ALL H89/H19 SPECIAL FUNCTION and KEYPAD keys come alive for WordStar™ users. You will have no more need for the "control" key to move the cursor or execute any command. Package includes a prologue program for labeling the 25th line, and a self-installing patch to WordStar (specify version). $19 ($2 manual only).

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GRAPH-IT: A versatile graphing system which will plot data from SuperCalc™, Condor™, dBASE II™, BASIC, or almost any program. Use any printer to plot up to 50 items or functions simultaneously, for any number of periods. Graphing formats can be quickly created and edited. Features include flexible scaling, text strings, labels from data files, user defined printer control strings, log plots, graph inversion, optional bar graphs, programmed ignoring of headers or data fields, and more. $29 ($3 manual only).

FLIGHT SIMULATOR: This is a simulator, not a game. It's tough and it takes some time to learn. Using your full screen instrument panel mockup, fly in either a glider, trainer, or 747. You define your runway and wind conditions, so when you get better, the going gets rougher. This program features some heavy aeronautical number crunching. It's fast, accurate, and challenging. After making coordinated turns, using your incremental flaps, or precisely flaring the 747 in a dead-stick landing, you'll know you've been flying. $19 ($3 manual only).

Diskettes are 5.25" hard-sectored, require CP/M 2.2(2.2.03 for 89/STAR). Please include $2 per order postage and handling.

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engineers who used FORTRAN on their PDP-8s." So Heath went to an outside consulting firm, Wintek of Lafayette, Indiana. Wintek sent Heath one of its programmers. Mr. Frenzel recalled his first meeting with this young man. "He had long hair and a long beard, high-top tennis shoes, and a velvet coat." But J. Gordon Letwin turned out to be "just a super programmer," and finally Heath realized, "Why in hell don't we just hire this guy?" So Heath "pirated him away from Wintek," and Mr. Letwin set to work on the Heath Disk Operating System (HDOS).

Mr. Letwin was something of an anomaly at Heath, which had little in-house software expertise and also tended towards a somewhat conservative corporate style. But, speaking to *Sextant*, he recalled his days there with pleasure. He pointed out that although some have criticized Heath's software support as inadequate, at the time it was more complete than software for any comparable system.

A serious software problem in the early days of the H8 was the Benton Harbor version of BASIC, whose precision was limited to six digits only, which reduced its applications potential considerably. For example, significant errors crept into financial and accounting programs dealing with sums of more than $9,999.99. This prompted some users to note that the only people who could safely use such programs couldn't afford them! Fortunately for H8 users, further improvements to Benton Harbor BASIC followed, and new language software also appeared on the market.

The past five years have seen a rapid increase in the availability of software for the H8. The first Heath catalog to include the H8 offered only a few programs such as Benton Harbor BASIC, several games, and a text editor. In the most recent catalog, more than twice as many pages were devoted to software alone as were given to the whole H8 system five years earlier. Programs now available from Heath/Zenith include HDOS and CP/M disk operating systems; Microsoft BASIC and FORTRAN programming languages; a program which allows a link to the CompuServe time-sharing computer network; the SuperCalc numeric worksheet; Magic Wand word processing; Peachtree business accounting programs; and the Heath Users' Group library of programs. Furthermore, a variety of independent software suppliers now serve the H8 market. These suppliers provide many programs such as word processors, mailing list managers, utilities, genealogical programs, color graphics packages, and arcade-style games.

(See *The Buss Directory*, Revision 6, in the Summer 1982 issue of *Sextant* for a full listing of all independent Heath/Zenith suppliers.)

The H8 has also benefitted from Heath's unique willingness to make its disk software source

SOFTWARE FOR THE H8/H89/Z89

Quality Products from NEWLINE SOFTWARE

TEXT PROCESSOR—* VERSION 3.5 ***

Text Processor is a screen oriented text editor designed especially for the H19/H89 terminal. The top twenty-four lines of the screen are used as a window into your text file. "What you see is what you get!" Each time you enter any keystroke, its effect is immediately displayed. The twenty-fifth line is used as a "COMMAND MENU." The keypad and function keys control most commands. Text Processor is designed to be easy to use, yet includes a full complement of powerful commands for fast and efficient entering and editing of text or programs. Text automatically wraps to the next line when the margin is reached. Built-in HELP facility and complete documentation are included. This editor even has an OOPS key to undo your mistakes! Control characters and escape sequences can also be inserted into your text for control of your printer features.

Requires — 32K memory min/40K advised **$39.95 (1,2)**

VIDEO ARTIST PLUS — * NEW RELEASE . . VERSION 4.0 ***

A unique graphics editor designed for creating graphic displays on the H19 terminal and saving the pictures to disk. Includes these features and commands: READ, WRITE, INVERSE, SCROLL SCREEN, CUT, PASTE, FILL, ERASE, GRAPHICS/REVERSE MODES, CURSOR ON/OFF, GRAPHICS GENERATOR, 8 DIRECTION CURSOR CONTROL, TWO SCREEN PICTURE BUFFER, INSERT LINE, DELETE LINE, DUPLICATE (in 4 directions), INSERT CHARACTER, HELP DISPLAY. Completely "MENU" driven. Uses the function keys and keypad for command entry. Complete documentation is included. Sample programs in both MBASIC and BHBASIC show how to add the pictures to your applications.

Requires — 32K memory **$39.95 (1,2)**

H25/Z25 GRAPHICS GENERATOR — * NEW PROGRAM ***

This program contains all of the features of Video Artist Plus for the creation of pictures on the H19 terminal and saving to disk. In addition, graphic displays can be sent from the screen of the H19 to the H25/Z25 printer! Screens can be combined to print 160 column wide by any length pictures. In addition to Video Artist Plus commands, the command set includes: 6/8 LINES PER INCH, 10/13.2 CHARACTERS PER INCH, TOP OF FORM, TWO SCREEN PRINT BUFFERS. A program in BASIC is included for printing continuous pictures from disk to the H25. Use this program to design your own INVOICES, STATEMENTS, LETTERHEADS, or just for fun GRAPHICS!

Requires — 32K memory **$44.95 (1, 2)**

TOUCH TYPIST — * HDOS AND CP/M VERSIONS ***

Touch Typist was written for the Health/Zenith computer users who use the old hunt-and-peck method of typing. And, for those who already know how to touch-type, Touch Typist has practice lessons to help improve your speed and accuracy. Touch Typist consists of a series of lessons which you can practice at your own pace. The program combines time tested techniques of teaching typing with the instant feedback only possible with a personal computer. See the Software Review in the January 1982 issue of Kilobaud/MICROCOMPUTING magazine for a complete review of this computer-aided instruction program.

Requires — 24K memory **(HDOS VERSION) $29.95 (1, 2)**
(CP/M VERSION) $29.95 (2, 4)

TOUR-700 — * NEW PROGRAM ***

Are you tired of the fast action games that seem impossible to win without at least 8 hands? This is the game for you. Based on an old card game played in Europe, this game will entertain and amuse you without tiring you out. A good mix of skill and luck-of-the-cards, this program will be enjoyed by youngsters and oldsters alike. The graphics features of the H19 are used to present a game board display. The object of the game is to win a cross country race against the computer. You must overcome flat tires, accidents, speed limits, and other hazards as you make your way through each 700 mile leg of the race. The computer will plot to place hazards in your way and try to beat you to the finish line. But with a little luck and some plotting of your own, you can win. The HDOS version includes both BHBASIC and MBASIC source code. The CP/M version is for MBASIC only.

Requires — 32K memory **(HDOS VERSION) $19.95 (1,2)**
(CP/M VERSION) $19.95 (2, 3)

Requirement Notes:
(1) HDOS 1.6 or higher
(2) H19/H89 terminal
(3) CP/M 2.x and MBASIC 5.1
(4) CP/M 2.x

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Kenneth Patrick writes on how to avoid sitting around for hours waiting for your printer, in "Print Spoolers: A Background and Reviews of Six Software Products to Break Your Printer Bottleneck."

J. C. Hassall's article, "A Parallel Interface for the '89" can give you an inside view of how the H/Z89 handles input and output of information.

Richard Smith tells readers how to program successfully without using the computer's operating system, in "Disk Programming *Without* HDOS".

Summer

William Clarkson explains how to "Put Some Structure in Your BASIC Programming"—so that you can more easily adapt BASIC to your Heath/Zenith system.

Bill Parrot's article "Crucial Secrets of HDOS Let You Write Device-Independent Programs" shows how to use the HDOS source code to your advantage.

The Z100 line is covered for the first time, with color photographs of the new model's exterior *and* interior.

Al Dallas writes about the special features of the central processor chip which makes the Z100 both powerful and reasonably priced—in "Introducing the Brain of the Z-Machine."

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listings public. H8 owner Dale Grundon of the Capital Heath Users' Group remarked that "it's been an educational five years," in part because "the total software listing has been a spectacular advantage." H8 owners who are interested in taking their software apart bit by bit (as it were) can achieve much greater control over their computers' operations than can people who program on an "appliance" type personal computer. Indeed, Heath's enlightened policy of making source listings available may have spurred H8 programmers to greater creativity than they would have shown if they were using an "appliance" computer. H8 programmers tend to have a more sophisticated knowledge of hardware than other programmers, and that, combined with the unusual access to operating software, has offered programmers exciting opportunities to make their machines perform. Of course, there is a greater risk of crashing the system, but H8 owners do tend to have an unusual degree of programming expertise. And, perhaps equally important, H8 owners are more resilient in the face of difficulties than are the technically unsophisticated.

In January 1979, Lifeboat Associates announced that in March of that year it would begin marketing an H8 version of the CP/M disk operating system. The introduction of CP/M vastly increased the amount of software available for the H8. This should not necessarily be interpreted to mean that CP/M is "superior" to HDOS. Each operating system does have its own special virtues. HDOS was designed to prevent inexperienced users from crashing the system as a consequence of their own folly. CP/M is not as strongly protected. Also, CP/M's documentation has been described in many ways, covering a wide spectrum from "cryptic" to "incomprehensible." HDOS, in keeping with the Heathkit tradition, is thoroughly and clearly documented. CP/M's virtue is that there are many more programs available to run on CP/M. This edge has been decisive in spurring CP/M's growth in the microcomputer industry, and many H8 owners have purchased CP/M. In November 1979, *Buss* reported a conversation with Barry Watzman, Heath/Zenith computer product line manager: "He said Heath may switch to a different operating system and indicates in hindsight that users would have been better off if Heath had adopted CP/M in the beginning." Tom Yeager said, "We shouldn't have been sitting on the fence; we should have either pushed HDOS more than we did, or gone with CP/M."

Owners

Who bought the H8, anyway? We've talked about the machine and its support, but not much about its owners. What are H8 owners like? First off, they tend to be confident in their technical sophistication, like Patrick McNamara of Englewood, Colorado. "I'm sure I know what I say: I'm very critical since I maintain computers for Control Data Corp." Of computer hobbyists surveyed by Murray Nichols, then market research director for Heath, 57% were engineers, computer specialists, or scientists, according to an article in

The H8 has also benefitted from Heath's unique willingness to make its disk software source listings public.

REMark #2. Using the same figures, and assuming that the pool of 1977 hobbyists is largely similar to the pool of 1982 H8 owners, we see that 45% have had postgraduate education. Some 32% rated their own software knowledge as excellent or very good, and some 46% assessed their hardware skills the same way. Still, computer hobbyists tend to be young: 71% are 25-44 years of age.

H8 owners also tend to have motivations which reflect their highly educated background. Mr. Nichols' surveys revealed that there was "no doubt that the biggest reason hobbyists want computers is because they are fascinated by them and want to learn about them." *Sextant*'s recent survey verified this assertion. Time and again, our respondents

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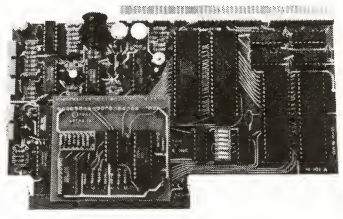

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cited one explanation in particular for purchasing the H8: a desire to learn about computers. The H8's skilled, curious, and energetic owners seem to have learned a great deal from the H8. And thanks to the Heath Users' Groups, they have learned a great deal from each other. Mr. James Czebiniak of Schenectady, New York, said to *Sextant*, "I think one of the things that impresses me most about Heath computers is the closeness and tightness of the user community." Indeed, the next issue of *Sextant* will focus on local and national Heath Users' Groups. We are honoring the H8 in this issue, and we believe that its owners deserve equal credit.

The Future of the H8

Heath/Zenith had to discontinue production of the H8 in 1981, because of an unforeseen development. The Federal Communications Commission set permissible radio frequency radiation limits for computing equipment. It would have been necessary to redesign the H8 in order to meet these new standards. Retooling the production line would have been too costly to justify continued production of the H8. Has the H8 died? Not entirely: Heath/Zenith is still selling H8 kits from its stock. It is still possible to buy used H8s. And Heath/Zenith officials have repeatedly affirmed their intention to continue support for the H8 for seven years. This is a matter of company policy. It is not mandated by law, as some erroneously believe. Heath has given many indications that its policy will be steadfast, and the independent suppliers are still healthy and active, so it should be possible to keep an H8 functional for the indefinite future. This raises a more fundamental question: will the H8 be useful in the future?

One philosophic reader at Yankee Clipper Processing in Carmel, New York, answered this question by saying, "Who can *really* see into the future?" Well, perhaps your friends here at *Sextant* can, thanks to the helpful responses we received from our survey of H8 owners. They had some plausible predictions to offer. Some H8 owners have expressed concern that the quality of Heath/Zenith support may decline. Heath showed off its new WH8-37 Double-Density Disk Controller and Z-67 Interface at the West Coast Computer Faire in March 1982, with delivery set for August or September. This is expected to be the last new hardware product for the H8. Many owners fear that Zenith will now turn all of its attention to the new Z100 series of personal computers. Users are also concerned that they may become isolated from the computing mainstream if they stay with the H8 while fellow users abandon the H8 in favor of newer, more powerful, models. Dale Grundon of the Capital Heath Users' Group had a glum perspective: "My H8 is five years old, and I'll probably want to replace it with a Z100 series model. The nature of computer technology is such that these things become obsolete quickly." One anonymous respondent had this succinct comment on the future he saw for the H8: "obsolescence"; or, as another respondent pithily predicted, "death."

But *Sextant*'s survey did turn up some substantial reasons for owners to be more optimistic about the future of the H8. For one thing, there are many satisfied users who are committed to the H8 simply because they have invested heavily in the system, its accessories, and its software, and they cannot afford to buy another system. Another reason for optimism is that the H8 still fills a unique niche in the computer market. The H8 will continue to be successful as long as it can hold the support of computer enthusiasts who enjoy the opportunities the H8 gives them. After all, it still does function, regardless of outside technological developments. And finally, Edmund M. Coleman, Jr., of Winston-Salem, North Carolina, noted one possibility which hadn't occurred to *Sextant*. "The H8 will be cast aside for newer 16-bit machines, but will become [a] collector's item. Fifty years from now they will lead the collectibles of the microcomputer era as the only machines of their era that still work." A wise verdict, we think; in the meantime, we can safely join the Heath/Zenith users' community in wishing the H8 a happy birthday, and many happy returns.

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Comment

Heath Company's H8: The Computer Enthusiast's Choice

Charles Floto

The market for microcomputers may be subdivided in several different ways. Currently many manufacturers are addressing the segment represented by small business and professional users. A mass market for microcomputers is often forecast with development of a user-friendly home computer. Several video game manufacturers are active in this area.

A third market sector which has been crucial in the past currently attracts less vendor interest. It is commonly called the hobby market. But many who started as hobbyists have become computer industry entrepreneurs. Others have managed to convince either their spouses or the Internal Revenue Service that their hardware and software has vocational application. So I prefer to describe this neglected segment of the microcomputer marketplace as computer enthusiasts. They zealously follow technical developments and ardently pursue the most aesthetically satisfying programming language or algorithm.

Computer enthusiasts find themselves held in contempt by many manufacturers. To what vendors can they turn for support? I will suggest that the Heath Company deserves their attention and that the current machine of choice for the computer enthusiast is the H8.

Distinguishing Features of Heathkit® Computers

Four characteristics distinguish the Heath Company product line from alternatives such as the TRS-80, PET, Apple II, and S-100 machines.

1. *They are available as kits.* Heathkit buyers have an opportunity to become intimately familiar with the interiors of their computers. By contrast, buyers of other microcomputers are routinely warned not to even look inside lest they violate the terms of their warranties. For the computer enthusiast it should not be hard to choose between the vendor which encourages intimacy and those which scream of violation.

2. *Heath sells the source listing of its disk operating system.* The available code includes HDOS, an 8080 assembler, a line editor, and a BASIC interpreter. This is the software for the H8 and H89. Heath also sells the source code of its cassette system software for the H8 and H88.

Other software vendors may wonder why Heath is so profligate with its source code. The computer enthusiast, however, should applaud the attitude expressed in the firm's catalog: "Source Listings for selected Heath computer software give you a better understanding of system operation." I must confide that some Heathkit owners have gone beyond understanding HDOS and have taken to modifying it.

I wouldn't want other software vendors to do no more than recoil at the thought of users making changes in a commercial software product. So I'd like them to consider how much profit Heath must make selling source listing at about $9 per pound. Selling printed source code carries minimal risk of software theft when the price is comparable to that of the machine-readable object code.

3. *A large proportion of Heath's computer sales have been to its existing base of customers.* The Heath company counts 900,000 customers. Thus it was able to enter the microcomputer market with less magazine advertising than Apple or Radio Shack. One result has been an initial lower visibility. I suspect another effect may have been that Heathkit computer owners initially included a somewhat lower proportion of computer magazine readers.

A more significant consequence is that many Heathkit computer owners are neither computer professionals nor unsophisticated users. Rather they are dedicated kit builders. They may be involved in medical, engineering, or military careers. Another group of Heathkit owners are sophisticated bargain hunters attracted by Heath's increasing magazine advertising.

4. *Heath Company is part of a three-pronged attack on the total microcomputer marketplace.* This attack has been developing since 1979 when Heath was acquired by Zenith Radio Corporation. Zenith's future activities in the home computer marketplace have been set for sales through stores that handle its television sets and video cassette recorders. Zenith Data Systems aims at the small business and professional markets through sales by independent computer stores.

The third element of this corporate strategy makes Heath Company the only firm in the computer industry with an exclusive charter to serve the home user and hobbyist. Other vendors have been abandoning the hobby market, which Heath forecasts will account for only 5% of microcomputer sales by 1984. But this small slice is put at $160 million, with little competition for the Heath Co. in prospect.

Computer enthusiasts who have chosen a product of any other vendor may find their suppliers concentrating future product plans on the home computer and small business markets. Since Zenith is structuring its microcomputer activities to make sales to enthusiasts readily visible on its financial records, it is

less likely to overlook their importance.

Features of the H8

The H8 is bus-oriented with a sophisticated front panel. The latter features a keypad and nine 7-segment LEDs. It's quite a step up from the toggle switches and lights of most S-100 front panels. But the H8's most significant physical feature is the hole in the middle. Heath has provided room for seven circuit cards. Its early boards didn't make very efficient use of the space. But now there's a controller for 8" floppy disks with two serial interface ports. Add a 64K memory board and you'll have your I/0, memory, and mass storage taken care of with five positions left for your choice of frills.

Heath has taken care of two deficiencies that may have cost the H8 some sales to computer enthusiasts. The H8 (or H89) owner now has access to CP/M-based software. Some of this is sold by Heath on 5.25" or 8" disks. Prices are $100 or more below what other vendors charge. Heath prefers to pay a flat fee for the right to distribute software for use with its hardware. Other vendors pay a royalty on each copy sold, and are permitted to deal with the general marketplace.

The second deficiency Heath has cleared up by offering a color video board based on the Texas Instruments 9918 color video generator. This provides resolution comparable to the Apple, but far superior support for moving images.

Characteristics of Heathkit Owners

Technical sophistication is common among Heathkit owners. As noted earlier, many of Heath's computer customers are dedicated kit builders. A survey I conducted in 1980 revealed that 20% have an amateur radio license. At least 90% of these hams have passed FCC tests beyond the Novice level. The most common class of license held is Advanced (40%), followed by Technician (22%), General (16%), and Extra (10%). The survey found H8 owners 50% more likely to have an amateur license, compared to H89 or H11 owners. About 15% of the latter two groups are hams.

Programming experience is common among Heathkit owners. When 1632 survey recipients were asked "How much of your software do you write yourself," 39% said "Most." "Some" said 36%, with 17% choosing "A bit" and 8% saying "None." About half the H11 owners said they write most of their software, compared to 35% of H89 users.

The H8 and the Computer Enthusiast

The H8 is a bus-oriented microcomputer available as a well-documented kit. Its HDOS disk operating system is available on 5.25" disk, 8" disk, and as 8080 assembly language source code. Heath Co. also supplies CP/M software for the H8. The H8 owner using 8" floppies has direct access to the full range of CP/M software from numerous vendors.

Heath Co. is not the only supplier supporting the H8. Many others are listed in the directory of suppliers on pages 63-78 of the Summer *Sextant*.

Languages available under HDOS include BASIC, tiny-c, FORTRAN, RATFOR, and LISP. Pascal is available for the H8 in several versions.

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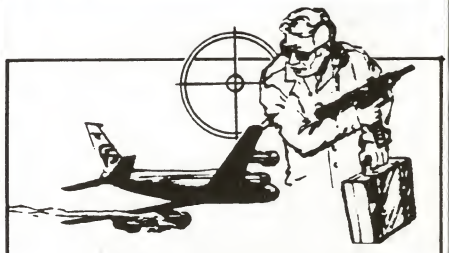

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Putting the "O" in "OEM": Magnolia Microsystems

Hal Glatzer

The "O" in "OEM" stands for "original," and Magnolia Microsystems, Inc., of Seattle, Washington, has proven itself to be just that. As an "original equipment manufacturer," Magnolia takes Heath/Zenith products and turns them into powerful computer systems—often ahead of Heath or Zenith themselves.

Magnolia is a family business, owned by a husband-and-wife team, Brad and Kay Gjerding: he's an engineer, responsible for product development and testing; she's an attorney, and runs the business office. The company and its 15-20 employees are housed in a two-story, modern building near the Gjerdings' home in Seattle's Magnolia district—where magnolia trees flourish in the temperate, maritime climate.

"We started in 1975, as BK Gjerding Electronics, to do research and development of flight-simulation CRT display systems under contract to NASA," says Kay. "Because of our knowledge of the microprocessor field, and our connections with the suppliers of chips, we had a head start on the microcomputer industry that was just then emerging."

Brad explains that they began to receive requests from local businesses and individuals who wanted custom computer systems. "Generally, they were small business and professional people who saw that microcomputers would handle accounting, word processing, and a few specialized applications that they couldn't get, cost-effectively, from the existing hardware or software suppliers. We divided our time between the NASA contract and our computer business until the microcomputer side dominated our time. That's when we changed our name to Magnolia Microsystems, to reflect our commitment to small computers."

Learning to love the H89

By 1979, Kay and Brad were dealers for the Peachtree accounting packages, but the high cost of those packages—and the expensive micros they required to run—were often outside their customers' price range. They looked around for a less-expensive hardware system that could run the Peachtree software and found, in a Heath catalog, a listing for Peachtree products that would run under the Heath Disk Operating System (HDOS) on the H89.

"We ordered both a kit and a wired-and-tested unit, but the Peachtree software was never released under HDOS," says Kay. "But we found, in the '89, a computer that also lent itself to custom work. Since our business frequently required custom hardware and software work, the '89 was the best starting-point system we'd found."

"It appeared, to us, as a reliable and well-built small computer," says Brad, "but we felt its usefulness to our customers and, therefore, its sales potential, were limited by its operating system—which was HDOS. If we could install CP/M in what was then the Heath product, the computer would be a very capable, state-of-the-art microcomputer indeed." Digital Research's CP/M has become the most popular operating system in the industry, with an enormous library of application programs available for it, because software written on one computer can be easily transported to other systems. As a result of their efforts, says Brad, Magnolia has over 2,000 CP/M customers worldwide.

But the '89 had other limitations, among them its internal memory. Its 48K random access memory (RAM) was inadequate for many applications with large files of words or data. Magnolia brought out a 16K RAM board which boosted the

Magnolia Firsts for the '89

Double-density disk controller boards, and interfaces for mixing and matching disk drives.

A 128K RAM expansion board that works like an "invisible" disk drive.

Video output for external monitor displays, projection TV, and video tape recording.

And—the most popular innovation of all—CP/M. Magnolia has offered CP/M for Heath/Zenith computers since 1979.

RAM to 64K, with CP/M to take advantage of the expanded memory.

The original Heath disk controller board could handle only a maximum of three hard-sectored, 5¼" disk drives, with 90K capacity on each single-sided disk. Magnolia doubled the capacity of the Heath controller board by providing software (within their CP/M) to run double-sided drives—up to 180K on each disk. Eventually, they developed a true double-density disk controller board which could store up to 700K bytes of information on a 5¼" diskette.

> ***"Zenith has sent us customers whose needs they, themselves, are unable to meet."***

Magnolia had previously brought out disk interfaces that permit the '89 to use Winchester (hard disk) drives with 5, 10, and 20 megabytes of storage, and to link them together for up to 80 Mbytes of on-line storage. "The double-density controller has made enormous amounts of disk storage available to our customers," says Kay, "and has generated a lot of sales and plenty of attention among hobby and technical people."

In 1982, Magnolia introduced an expansion-RAM board with 128K bytes on it. Since the '89 can only address 64K bytes (a natural limitation in every 8-bit microcomputer), Magnolia offers the 128K RAM board with instructions for making it appear as an "invisible disk drive" that can record and play back information much faster than its hardware counterpart. CP/M reaches all physical disk drives through the intermediary of a "logical disk drive" *name*. By assigning Magnolia's 128K RAM a similar name, it is easy to configure it as a drive; Magnolia's CP/M includes a utility for doing that. It is also possible to divide the 128K RAM among several users under MP/M, Digital Research's multi-user system.

In 1981, the Gjerdings secured the prototype of a new product from independent computer experimenters. Unable to mass-produce or market it themselves, they had been recommended to Magnolia by a potential customer.

The Heath/Zenith computers have their own screen built in, which serves one or two viewers well; but there is no provision for reproducing that display on a separate monitor. From the prototype, Magnolia produced a small printed-circuit board that sends conventional video signals through a standard video jack to a video monitor or monitors of the user's choice. Priced at only $79, it has found ready acceptance in education and training, where

23
18 PROGRAMS FOR HEATH/ZENITH COMPUTERS

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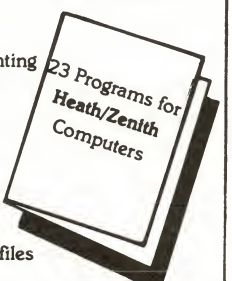

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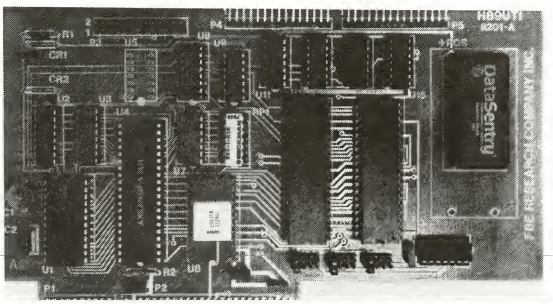

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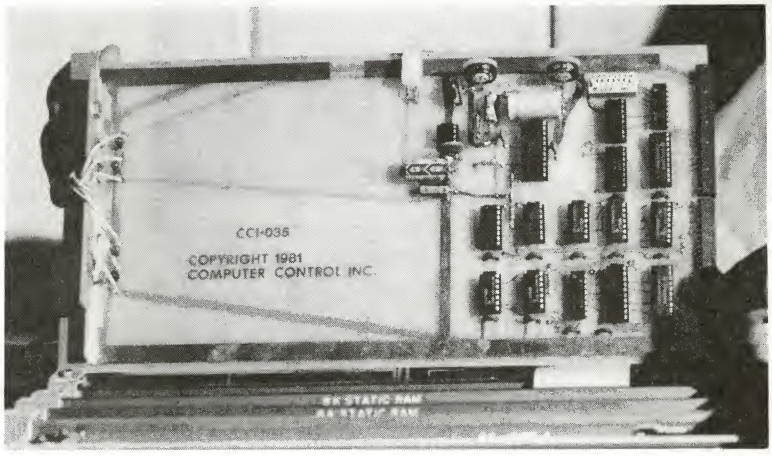

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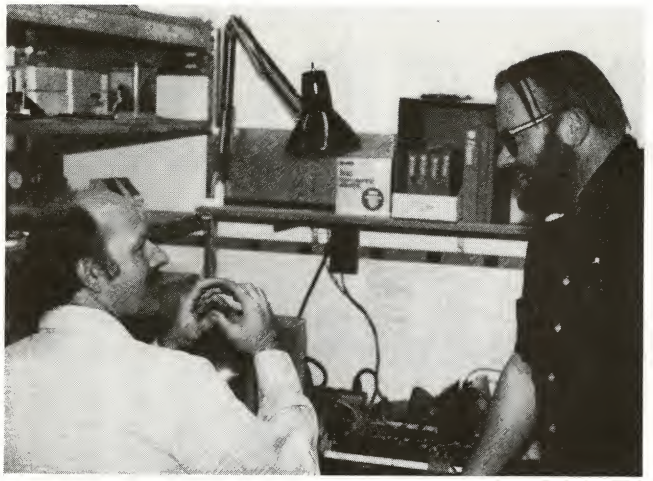

In Magnolia's hardware lab, technician Adams Bushnell (left) shares a concept with Doug Sauby.

external monitors, projection TVs, and videotape recorders are used.

Among Magnolia's customers are not only end-users but also other computer dealers. Heathkit Electronic Centers, custom houses for "vertical" market systems (customized hardware/software systems for particular professions, etc.), and other people who will re-sell the computers, are all customers. "Zenith has sent us customers whose needs they, themselves, are unable to meet," says Kay. "For example, customers who need relatively small quantities of custom products, or those who need rapid 'turnaround,' may not be as well served by the large organization as they are by a smaller and more narrowly focused company such as ours." Magnolia maintains a retail store of its own, with Altos, Columbia Data Products, and Xerox computers alongside the Zenith products, but its volume of shipped orders far outpaces local retail sales.

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The people behind the company

Brad Gjerding delegates responsibility for engineering many of Magnolia's products to two men named Doug. Doug Sauby is the hardware design lead; Doug Miller is the senior programmer/technician. "But none of us has titles around here," Miller insists.

Sauby is self-taught. "I spent years trying to find a double-density disk controller for home-brew computers, and built several of them from kits. But they didn't satisfy me, because they were not versatile. But the disk controller that we made here can handle 5¼" and 8" drives simultaneously—it's certainly one of the few boards that can do that. Software production houses use our boards to produce disks that are compatible with every drive that is supported by both Zenith and Magnolia—without changing any hardware.

"Between Doug [Miller]'s software and my hardware, we've got great things on that board. The controller chip maker wants to publish application notes about it," he says with a grin, "but Magnolia's going to hold on to that information and keep it proprietary."

By contrast, Magnolia has distributed the 128K RAM expansion board with complete applications information. "It's so versatile," says Sauby, "that we could not hope to come up with *all* the ideas for using it. We offer it as an 'invisible disk,' but other people can write their own applications." In spread-sheet accounting programs (such as SuperCalc), it can be used for "paging," to hold larger pages than the screen can show at one time; or it can store portions of pages that the user wants to save in a common location.

"I expect," he says flatly, "that that product alone will probably extend the production life of the '89s and '90s."

From Sauby's point of view, what Magnolia has done is make it possible for the '89 and '90 to grow with their users' needs. "You start with our 16K RAM board and CP/M and you've got a 64K computer with one of the most advanced versions of CP/M on the market. It not only offers all the features of CP/M but includes expansion capabilities through modules. Our CP/M supports the original Heath/Zenith disk controller whether you're running just one drive with 90K or the full capability: three drives, with up to 350K bytes each.

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CIRCLE #358 ON READER SERVICE CARD

interfaces for it, our CP/M has modules that can be linked together to create a system that is specific to a user's hardware. Defining the configuration requires no knowledge of programming, or machine language," he says. "We have a series of prompts on the screen that is concise and efficient."

One reason for that is Doug Miller's attention to detail in the software end of the business. With a background in 8080 microprocessor chip programming in both high school and technical school, Miller is largely responsible for putting CP/M on the '89. Among his tasks were the actual customizing of the Basic Input/Output System (BIOS), through which the operating system "recognizes" the terminal, and the creation of additional utility programs, such as FORMAT and SETUP, with which the user "tells" the operating system what kind of equipment is being connected to it.

(To me, as a writer, one of Miller's major accomplishments was customizing the word processing program Magic Wand to the '89. Early in 1980 he wrote an input/output (I/O) module. This small program enabled Magic Wand to use the keyboard's function keys, cursor arrows, insert, delete, and other keys. The effect was to make the '89 comparable to many stand-alone office word processors costing up to three times as much.)

"Our new release of CP/M, version 2.25, will take advantage of bank memory—that is, with the 128K RAM expansion board, we'll be able to switch memory into more than one 64K chunk of RAM. If the user puts the operating system into it, for example, it will leave a much larger chunk of RAM space for running programs, editing files, and so on," says Miller.

Asked about the future of programming, Miller responded, "I'm not terribly philosophical about software. As far as I'm concerned, it's pretty straightforward. You write programs so that they don't have bugs in them, and it's an ongoing struggle."

The Gjerdings share that attitude of quiet determination. "We're small, but we're involved in all the phases of the industry: research and development, manufacturing, sales, after-sale service, and marketing," says Kay. "Magnolia Microsystems has a nationwide reputation as a vendor of fine computer systems and superior software programs. Our hardware and software are both backed by a service staff that is prompt and skilled at problem-solving. Our customers include a multitude of different kinds of businesses, including a daily newspaper, attorneys, professional writers, and engineers in a dozen states. We take our time, and don't release anything until we're sure it works."

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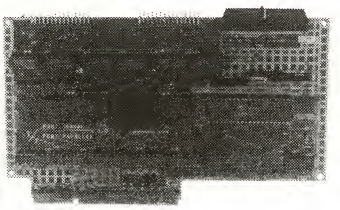

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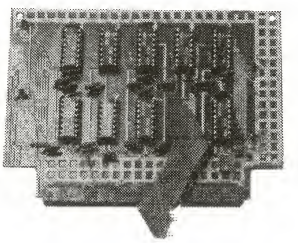

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Book Review

Experiment with Artificial Intelligence on your Heath/Zenith Computer

John S. Mays

Experiments
In Artificial Intelligence
For Small Computers
by John Krutch
Howard W. Sams & Co., Inc.
Indianapolis, IN, 1981.
110 pages. Softcover.
$8.95

The concept of Artificial Intelligence (AI) has been conjuring up fantasies for years. The idea of a machine that can think is fantastic to some, horrendous to others, and mind-boggling to most.

True AI is a long way off and I believe that the journey from here to there will consist of a series of small steps, one after the other, until someday, somehow, a breakthrough will allow the journey to be essentially completed with one quantum leap.

In *Experiments In Artificial Intelligence For Small Computers*, John Krutch not only describes the steps that have been taken so far, but allows us to take those same steps ourselves with our Heath/Zenith microcomputers.

The book

Krutch begins with a clear, concise introduction to AI. Although he neatly sidesteps the issue of whether computers will ever be able to "think" by stating that AI's goal is to make computers "smarter" (whatever that means), he addresses both the scope of AI and the problem areas of AI programming. He illustrates his points with simple BASIC programs. All the programs in this book, by the way, are well-written, using a structured, modular design and Microsoft's Level II BASIC for the Radio Shack TRS-80. I had no trouble converting the programs to run on my Heath computer, especially since Krutch includes an appendix which explains special keywords which are not in all dialects of BASIC. Some of the graphics routines need extensive rewriting, but, otherwise, you should have no trouble getting the programs up and running.

Krutch follows his introductory chapter with chapters on game-playing programs, problem solving, programs that reason, computer verse, computer-generated text, and natural-language processing. In each case, he explains the concepts involved in a straightforward manner, provides an illustrative program, and analyzes the program in detail. For example, when I finished the chapter on game-playing programs, I felt comfortable with evaluation techniques such as Minimaxing and the Alpha-Beta Algorithm. And I truly understood the "CHECKERS" program Krutch used as a vehicle to make his points.

I had no trouble converting the programs to run on my Heath computer, especially since Krutch includes an appendix which explains special keywords which are not in all dialects of BASIC.

The programs

All the programs are interesting in their own right, especially "HAIKU", which creates the classic Japanese verse, "AUTOWRITER", which turns out old-fashioned Science Fiction stories, and the well-known "DOCTOR", which is a version of "ELIZA", the famous psychotherapist script.

All of the programs are short, averaging about 120 lines each. The program listing shows a sample AI program, called "TF", adapted for use on an H/Z89. The idea of "TF" is simply to key in "T" or "F" in any pattern you choose, and the computer will attempt to guess which letter you will enter next. Krutch explains the program in detail, but,

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briefly, it works by determining the pattern of your last four entries. It then looks to see if you've entered that pattern before. If so, it will predict that you will follow the current pattern of four the same way that you followed it last time. If you haven't entered the pattern before, the computer will make a random prediction. Naturally, you must make four entries before the computer can begin to predict under this algorithm. The first four entries produce no response except to tell you that predictions start with the fifth entry.

A particularly delightful aspect of *Experiments In Artificial Intelligence For Small Computers* is the possible modifications to the various programs suggested by Krutch. Playing with these modifications allows the reader to *experiment* with some of the techniques of AI, rather than merely reading about them. These modifications are, for the most part, quite thought-provoking and worthwhile.

Experiments In Artificial Intelligence For Small Computers is a job well done. When you've finished it, you'll find that you've become the resident AI expert among your computer pals.

```
10 '        TF from EXPERIMENTS IN AI FOR SMALL COMPUTERS by JOHN KRUTCH
20 '
30 '        MODIFIED FOR MBASIC AND HEATH H-89/H-8 by JOHN S. MAYS
40 '
50 '       SUPERVISOR
60 GOSUB 140          ' INITIALIZATION
70 GOSUB 270          ' FIRST LE INPUTS FROM PLAYER
80 GOSUB 330          ' INPUT
90 GOSUB 600          ' PRINTING AND SCOREKEEPING
100 GOSUB 430         ' LOCATION UPDATE
110 GOSUB 540         ' MATCH-PATTERN UPDATE
120 GOSUB 470         ' LOCATION CALCULATION
130 GOTO 80
140 '       INITIALIZATION
150 RN = RND(-1)
160 FT = 0
170 LE = 4
180 E$ = CHR$(27)
190 El$ = E$ + "E"    ' CLEAR SCREEN
200 Y$ = E$ + "Y"     ' DIRECT CURSOR ADDRESSING
210 DEF FN C$(C1,C2) = Y$ + CHR$(C1+31) + CHR$(C2+31)   'CURSOR POSITIONING
220 L$ = E$ + "l"     ' ERASE LINE
230 PRINT El$
240 DIM Q(llll,2)
250 PRINT FN C$(10,35);"INITIALIZING"
260 RETURN
270 '           FIRST LE INPUTS FROM PLAYER
280 FOR I = 1 TO LE
290 GOSUB 330
300 MP(I) = CD
310 NEXT I
320 RETURN
330 '           INPUT
340 PRINT FN C$(6,20);"ENTER 'T' OR 'F' (OR ANY OTHER KEY TO QUIT)"
350 IF FT = 1 THEN GOTO 370
360 PRINT FN C$(8,20);"THE COMPUTER WILL BEGIN PREDICTING WITH YOUR FIFTH ENTRY"
370 PRINT FN C$(10,40);L$;"READY: ";
380 IP$ = INPUT$(1): IF IP$ = "T" OR IP$ = "F" THEN 390 ELSE 780
390 IF IP$ = "T" THEN CD = 1: GOTO 410
400 IF IP$ = "F" THEN CD = 0: GOTO 410
410 PRINT El$
420 RETURN
430 '           LOCATION UPDATE
440 IF CD = 1 THEN Q(LO,1) = Q(LO,1) + 1: GOTO 460
450 IF CD = 0 THEN Q(LO,2) = Q(LO,2) + 1
460 RETURN
470 '           LOCATION CALCULATION
480 A$ = " "
490 FOR I = 1 TO LE
500 A$ = A$ + MID$(STR$(MP(I)),2)
```

```
510 NEXT I
520 LO = VAL(A$)
530 RETURN
540 '          MATCH-PATTERN UPDATE
550 FOR I = 1 TO LE - 1
560 MP(I) = MP(I+1)
570 NEXT I
580 MP(LE) = CD
590 RETURN
600 '          PRINTING AND SCOREKEEPING
610 PRINT FN C$(12,30);"YOU TYPED:                    ";IP$
620 PRINT FN C$(14,30);"THE COMPUTER WAS PREDICTING: ";
630 IF Q(LO,1) > Q(LO,2) THEN TF$ = "T":T = T + 1: PRINT TF$: GOTO 680
640 IF Q(LO,2) > Q(LO,1) THEN TF$ = "F":F = F + 1: PRINT TF$: GOTO 680
650 RA = INT(2*RND(RN)+1)
660 IF RA = 1 THEN TF$ = "T": T = T + 1: PRINT TF$
670 IF RA = 2 THEN TF$ = "F": F = F + 1: PRINT TF$
680 IF TF$ = IP$ THEN NC = NC + 1
690 PRINT FN C$(16,30);"TOTAL NUMBER OF ENTRIES:    ";T + F
700 PRINT FN C$(18,30);"NUMBER OF CORRECT PRE-"
710 PRINT FN C$(19,30);"DICTIONS BY THE COMPUTER:   ";NC
720 PC = INT(((NC / (T + F)) * 100) * 10 + .5) / 10
730 PRINT FN C$(21,30);"PERCENT OF CORRECT PRE-"
740 PRINT FN C$(22,30);"DICTIONS BY THE COMPUTER:   ";PC;"%"
750 FT = 1
760 RETURN
770 '           CLEAN UP SCREEN AND QUIT
780 PRINT El$
790 PRINT "THANKS FOR PLAYING"
800 END
```


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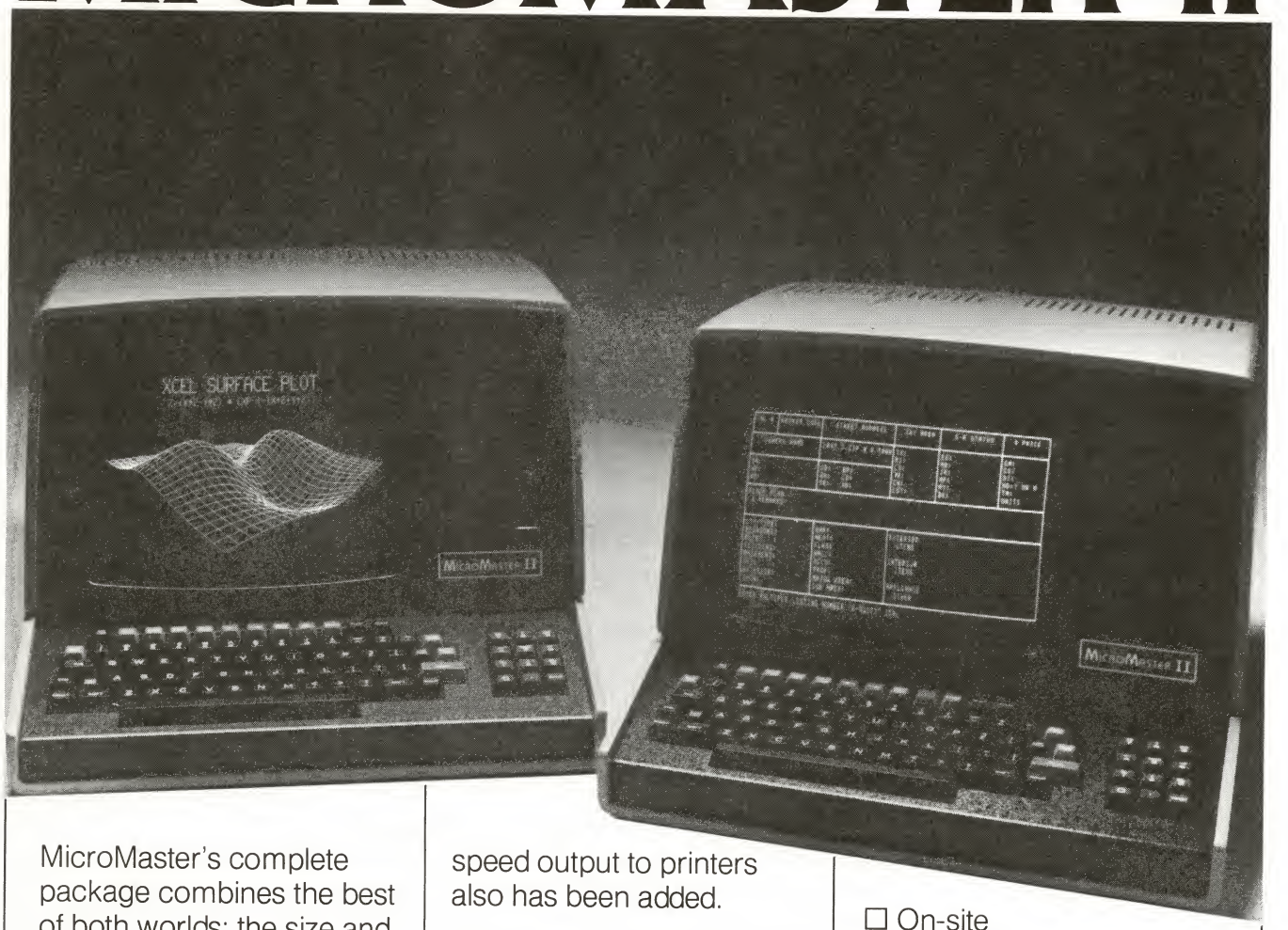

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CIRCLE #361 ON READER SERVICE CARD

The World's Fastest Sort?

Rick Lutowski

Sorting, the column-wise alphabetization of characters or sequencing of numbers, has always been an important operation in computer applications. As with much else in computers, the goal of sorting techniques has always been greater speed. And greater speed was what I found in packaging a new sort, the "address sort," for my company, Microtran.

The product, ADSORT, made its computer debut on Heath/Zenith equipment, being designed for use on the H8 and H/Z89 microcomputers. Yet the address sort appears to be a sorting technique of considerable significance to the computing industry as a whole. The mathematical properties of this sort promise to make it the high-power sort of the future. It is faster than any sort I've been able to test it against. But more than that, its mathematical characteristics appear to make it the fastest sort theoretically possible. Particularly for large amounts of data, no other sort should be able to surpass its speed.

Paradoxically, this sort of the future is based on one of the oldest sorting methods known, older in fact than computers. And certainly older than the sorts that are generally given as representative of simplicity or speed.

Background: the bubble sort and quicksort

One of the first sorting techniques used with digital computers was the bubble sort. This sort starts by searching all records (lines of data being sorted) for the minimum valued record. This record is then exchanged with the first record in the list. Starting with the second record, the entire list is again searched for the next largest record, which is exchanged with the second record in the list, etc. This "search and exchange" algorithm causes data records to rise to the top of the list as they are sorted, much as bubbles rise to the top in water, hence the name "bubble" sort. Unfortunately, the bubble sort, while simple and straightforward, has proven to be impractically slow for sorting large numbers of records.

The search for greater sorting speed resulted in the development of many new and clever sorting algorithms, the most famous of which is quicksort. This sorting thoroughbred is based on a technique sometimes referred to as "half-splitting," i.e., the data list is halved and each half-list is processed. Then each half-list is halved and processed. And so on, and so on.

What's the process? It gets a bit complicated. Quicksort chooses a number (or item) at random, halving the list. Then it looks at the numbers *following* the number chosen. If they're higher, they are left where they are. If they're *lower*, they're moved to the *first* half. Then it does the reverse for the first half: moving *higher* numbers to the *second* half. Then it halves each of the halves and goes through the same process all over again for each of *them*. So where you had two sections, you now have four. Then eight, and so on. When each section has only one number in it, they are sorted in order.

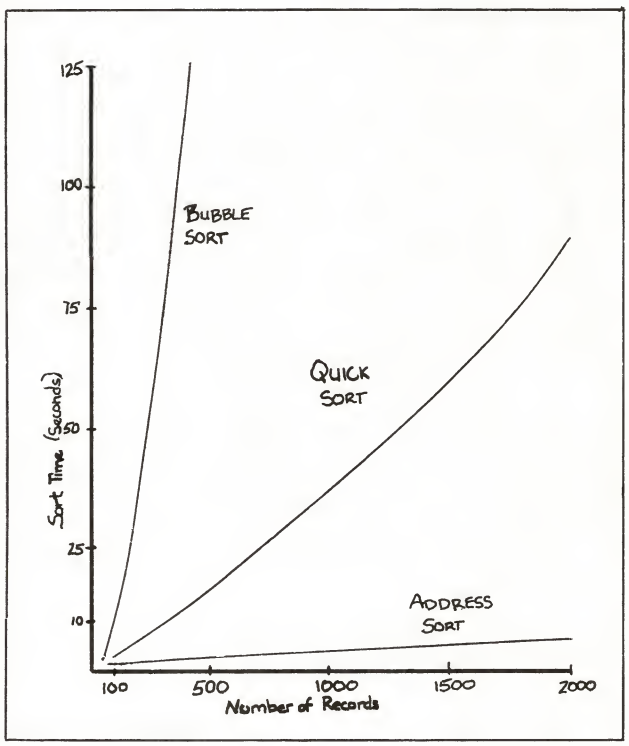

Figure 1. Sort time comparison for 16 bit integer records on 2 MHz Heath H8.

The most significant aspect of the quicksort, though, is not how it works. Rather it is that quicksort is widely acknowledged to be the fastest sort algorithm yet developed.

Genesis of the address sort

Early in my computer career, I had the good fortune to meet and work with Michael E. Aughey. Mike specialized in getting slow programs to run

quickly. His approach was two-pronged: 1) rewrite the code with a faster algorithm; and 2) clean up the code itself. The results were spectacular. Programs that ran in hours, or even days, would run in minutes, or even seconds, after being "Augheyized." It must have been in the process of Augheyizing a sorting program that Mike developed something he called an "address" sort. His ADSORT subroutine became famous throughout the

Particularly for large amounts of data, no other sort should be able to surpass its speed.

office as a speed burner, another of Mike's many triumphs against time. However, I, for one, had difficulty understanding how ADSORT worked. One day, he explained it all in a nutshell. "Rick," he said, "it operates just like the card sorter."

The card sorter was an old Electronic Accounting Machine, a large gray electro-mechanical dinosaur of computing's earliest years. You stacked a deck of IBM cards in the input hopper, and adjusted a dial to point to a chosen column of the card. The machine then read each card and threw it at great speed into one of 12 bins based on the punch in the selected column. The cards with a punch in the "1" position of that column went into the "1" bin; the twos into the two bin, and so on. After it had read the entire deck, the operator would take the cards out of the bins and stack them sequentially, one bin's on top of another's. The cards were then reloaded into the input hopper, the dial turned to point to the next column, and the process repeated. This was done for each column of the data field being sorted. At the end of the process, the cards were in order. As you can imagine, sorting cards this way was not very thrilling work. (Although it beat sorting them by hand!) As digital computers became more widely available and powerful, the card sorter was gladly forgotten, and new sorting algorithms—such as the bubble sort and quicksort—were developed for the new machines. Perhaps in their eagerness to rid themselves of the mechanical monster, no one ever considered the way the card sorter worked when designing sorting programs. No one, that is, except Mike.

In his never-ending quest for processing speed, Mike realized that the card sorter's technique, translated into code, would make a very fast sorting program. After he developed the algorithm, other interesting characteristics came to light:

1. the address sort could be applied to text data as well as numerical data;

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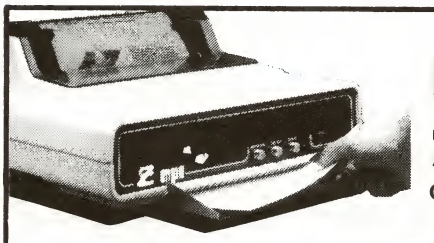

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2. it could sort in any user-specified order, i.e., A, B, C, ... Z, a, b, c, ... z; *or* A, a, B, b, C, c, ... Z, z; *or* A, Z, B, Y, ...; you name it;
3. it took the same time to sort regardless of the initial order of the data; and
4. it used no conditional (e.g., IF) statements.

Mike especially liked this last feature, since it was unheard of to write a sort algorithm without IF statements. Also, Mike may have believed that the lack of IF statements accounted for the algorithm's great speed. As he put it, "It doesn't ask any questions, it just *does* it!"

Unfortunately . . . the address sort does have a drawback which can impose limits on its application.

While the lack of IF statements was certainly remarkable, the true explanation of the address sort's speed lies in mathematics. Mathematical analysis reveals that the address sort appears to be very extraordinary, indeed. More than being just a very fast sort, I believe it can be demonstrated mathematically that the card sorter algorithm is the *fastest possible* sort for large numbers of records. Facing the same conditions (machine, language, data, etc.), it appears that no sorting algorithm developed to date, *or that will be developed in the future*, can be faster!

The address sort in the real world

How does this apparently spectacular sorting algorithm work? Like the card sorter, certainly, but many of you who have never seen such an antique may have a hard time relating to that description. So, let's illustrate it another way.

Suppose we wished to sort a deck of playing cards by suit, with the cards within each suit arranged in ascending order, like so:

2, 3,. . .Q, K, A	2, 3,. . .Q, K, A
Spades	Hearts
2, 3,. . .Q, K, A	2, 3,. . .Q, K, A
Diamonds	Clubs

This problem would be solved using an address sort as follows.

1. Starting with the top card of the deck, place each card in a separate pile depending on its value. This results in a pile of 2's, a pile of 3's, etc.
2. Stack the piles on top of one another, 2's or Aces

Data array used in an address sort.

Five single-subscripted integer arrays are required.

1. INPUT-DATA (NUMBER-OF-RECORDS)

INPUT-DATA contains single-byte data to be sorted. Because it is eight-bit data, the values always fall within the range from 0 to 255 (decimal)—reflecting the 256 possible permutations of 1 and 0 on each of the eight bits. The length of INPUT-DATA is equal to the number of records being sorted, i.e., "number-of-records."

2. INPUT-ORDER (NUMBER-OF-RECORDS)

INPUT-ORDER contains pointers to the INPUT-DATA array. These pointers reflect the initial order of the data records, as follows:

INPUT-ORDER (1) = pointer to 1st data record in input order
INPUT-ORDER (2) = pointer to 2nd data record in input order
INPUT-ORDER (3) = pointer to 3rd data record in input order, etc.

Thus, the order of the INPUT-DATA records is changed by changing the INPUT-ORDER pointers, not by physically moving the contents of the INPUT-DATA array. This contributes to higher sorting speed, and also leaves data records intact. The length of INPUT-ORDER is equal to the number of records being sorted, i.e., "number-of-records."

3. SORT-PRIORITY (256)

SORT-PRIORITY specifies the sort priority of the 256 possible data values (i.e., values 0 to 255) as follows.

SORT-PRIORITY (1) = sort priority of the 000 data value
SORT-PRIORITY (2) = sort priority of the 001 data value
SORT-PRIORITY (3) = sort priority of the 002 data value, etc.

For ascending numeric sorts, the SORT-PRIORITY contents are

SORT-PRIORITY (1) = 1,
SORT-PRIORITY (2) = 2,
SORT-PRIORITY (3) = 3, etc.

For descending numeric sorts, the SORT-PRIORITY contents are

SORT-PRIORITY (1) = 256,

first, depending on whether you prefer an ascending or descending sort.
3. Again starting with the top card of the deck, place each card in a separate pile depending on its suit. Add cards to the bottom of the piles or, equivalently, turn them over and add them to the top of the piles. This results in a pile of spades, a pile of hearts, etc.
4. Stack the piles on top of one another, starting with the suit you want on top, and ending with the suit you want on the bottom.

The address sort technique is widely used in many ways. Most games of Solitaire, for example, are masochistic variants of the address sort. Mail is sorted into post office boxes by address. (Now it should be clear why it is called an "address" sort!) The way we place money into cash register bins is an address sort by denomination. And, as we have seen, early computing machines sorted IBM cards using an address sort based on the "value" of the punches. The address sort is probably the oldest sort known, as well as the most widely used. It is therefore ironic that, in their search for greater sorting speed, the computer geniuses of our day missed the fastest sort of them all by ignoring the ubiquitous! The moral may be expressed nicely in the state motto of Michigan, the home of the Heath Company: "If you seek a pleasant peninsula, look about you."

How fast is an address sort?

The address sort computer algorithm consists of four loops. Two of the loops operate on the input records and, thus, are executed once for each record. The other two deal with the counter array, which results in 256 passes through each of these loops.

```
Loop 1: for LOC = 1 to 256
    :
end loop
Loop 2: for RECORD = 1 to NUMBER_OF_RECORDS
    :
end loop
Loop 3: for LOC = 1 to 256
    :
end loop
Loop 4: for RECORD = 1 to NUMBER_OF_RECORDS
    :
    end loop
```

An extremely important aspect of the algorithm is that none of these four loops is nested within another. Rather, they are executed in

SORT-PRIORITY (2) = 255,
SORT-PRIORITY (3) = 254, etc.

Character sorts may utilize any sort priority. Usually, however, the SORT-PRIORITY contents for character sorts will be the same as for ascending or descending numeric sorts.

4. COUNTER (256)

The COUNTER array is where the "dirty work" of the sort takes place. This array is a series of 256 counters, one for each possible data value. The SORT-PRIORITY array assigns a COUNTER element to serve as the counter for a particular data value, as follows:

COUNTER-LOC-FOR-000 = SORT-PRIORITY (1)
COUNTER-LOC-FOR-001 = SORT-PRIORITY (2)
COUNTER-LOC-FOR-002 = SORT-PRIORITY (3), etc.

Recall that the value of a SORT-PRIORITY element is defined as the sort priority of the data value represented by the element (see above). The data value with the highest sort priority is identified by a SORT-PRIORITY value of 1. Therefore,

COUNTER-LOC-FOR-DATA-VALUE-OF-HIGHEST-SORT-PRIORITY =
SORT-PRIORITY (n) = 1

or

COUNTER (1) = number of records with data value of 1st sort priority
COUNTER (2) = number of records with data value of 2nd sort priority
COUNTER (3) = number of records with data value of 3rd sort priority, etc.

5. OUTPUT-ORDER (NUMBER-OF-RECORDS)

OUTPUT-ORDER contains pointers to the INPUT-DATA array. These pointers reflect the order of the data records on output from the sort, as follows:

OUTPUT-ORDER (1) = pointer to 1st data record in output order
OUTPUT-ORDER (2) = pointer to 2nd data record in output order
OUTPUT-ORDER (3) = pointer to 3rd data record in output order, etc.

The length of OUTPUT-ORDER is equal to the number of records being sorted, i.e., "number-of-records."

straight sequence. The sequential nature of these loops sets the address sort apart from other sort algorithms; other sorts consist of loops that are nested in one way or another. Nested algorithms are always slower, mathematically speaking, than sequential algorithms, since every time you pass through one loop, you must pass through the nested loops as well. Thus, the *totally sequential structure of the loops* is the ultimate source of the address sort's great speed. The following analysis shows how sequential structure translates to speed.

The time to execute the first loop is proportional to the number of passes through the loop, i.e., 256. This can be represented mathematically as a simple equation:

$T1 = 256 \times t1$

where T1 is the total time to execute Loop 1 and t1 is the measured time for one pass through Loop 1.

Likewise, the time to execute the other three loops is

$T2 =$ NUMBER_OF_RECORDS $\times$ t2 (for Loop 2)

$T3 = 256 \times t3$ (for Loop 3)

$T4 =$ NUMBER_OF_RECORDS $\times$ t4 (for Loop 4)

Next comes the important step of combining the individual loop times into an equation for the total sort time. Since the loops are sequential, the total time (T) to execute the entire sort is simply the sum of the individual times.

$T = T1 + T2 + T3 + T4$

Since $T1 = 256 \times t1$, etc, the total time (T) may be written:

$T = (256 \times t1) + (N\_of\_R \times t2) + (256 \times t3) + (N\_OF\_R \times t4)$

Applying some simple algebra results in the equivalent equation

$T = ([t2 + t4] \times$ NUMBER_OF_RECORDS$) + C256 \times [t1 + t3])$

For a given computer, t1 through t4 (the times for one pass through each of the loops) is always the same. Thus, the expressions $(t2 + t4)$ and $256 \times (t1 + t3)$ are each a constant. Let's call these constants A and B, and rename the terms in the expression as follows:

$A = t2 + t4$

$B = 256 \times (t1 + t3)$

By substituting A and B in the equation for T, we get

$T = (A \times$ NUMBER_OF_RECORDS$) + B$

This is a simple linear equation, and the A and B constants are the linear coefficients. Linear equations can be plotted as a straight line on a piece of graph paper once the values of the linear coefficients are known. We can determine the values of A and B on a given computer from timing tests. The table below lists the values of these coefficients for a FORTRAN implementation of the address sort on a 2 MHz H8.

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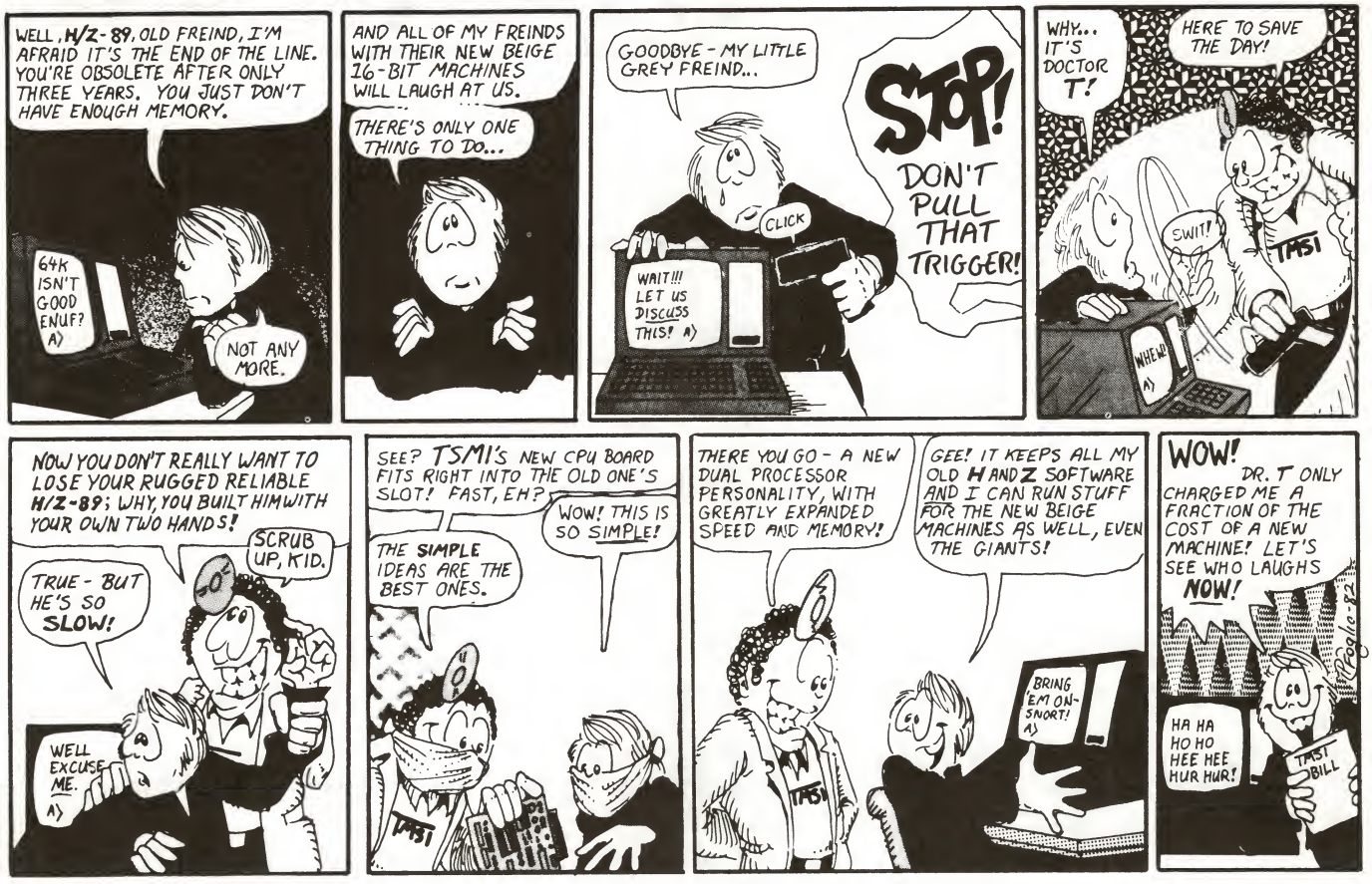
WELL, H/Z-89, OLD FREIND, I'M AFRAID IT'S THE END OF THE LINE. YOU'RE OBSOLETE AFTER ONLY THREE YEARS. YOU JUST DON'T HAVE ENOUGH MEMORY.
64K ISN'T GOOD ENUF? A)
NOT ANY MORE.
AND ALL OF MY FREINDS WITH THEIR NEW BEIGE 16-BIT MACHINES WILL LAUGH AT US.
THERE'S ONLY ONE THING TO DO...
GOODBYE - MY LITTLE GREY FREIND...
CLICK
WAIT!!! LET US DISCUSS THIS! A)
STOP! DON'T PULL THAT TRIGGER!
WHY... IT'S DOCTOR T!
HERE TO SAVE THE DAY!
SWIT!
TMSI
WHEW!
A)
NOW YOU DON'T REALLY WANT TO LOSE YOUR RUGGED RELIABLE H/Z-89; WHY, YOU BUILT HIM WITH YOUR OWN TWO HANDS!
SCRUB UP, KID.
TRUE - BUT HE'S SO SLOW!
WELL EXCUSE ME. A)
SEE? TSMI'S NEW CPU BOARD FITS RIGHT INTO THE OLD ONE'S SLOT! FAST, EH?
WOW! THIS IS SO SIMPLE!
THE SIMPLE IDEAS ARE THE BEST ONES.
TMSI
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GEE! IT KEEPS ALL MY OLD H AND Z SOFTWARE AND I CAN RUN STUFF FOR THE NEW BEIGE MACHINES AS WELL, EVEN THE GIANTS!
BRING 'EM ON-SNORT! A)
TMSI
WOW! DR. T ONLY CHARGED ME A FRACTION OF THE COST OF A NEW MACHINE! LET'S SEE WHO LAUGHS NOW!
HA HA HO HO HEE HEE HUR HUR!
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The Highlights of the Super 89:

- Twice the operating speed (4MHz+)
- Memory Capacity to 256 K in Software Bank Selectable 64K blocks
- CP/M and HDOS Compatible without modification
- Twice the number of expansion slots (Six)
- Real time clock on-board
- Two serial I/O Ports
- Designed for multi-user capability
- Parity checking for RAM assures integrity of memory transfer operations
- Arithmetic processor provision facilitates mathematic operations

These features, along with an enhanced monitor to access to all the Z80 CPU, give you power from your 88-89 that only large computers can claim.

High Speed Processing

The Super 89 runs twice as fast as the standard H/Z CPU board. Time savings on running programs are significant.

Expanded Memory Capacity

This feature allows you to use the advantages of the more sophisticated programming languages; enables you to use enhanced memory software such as print spoolers and electronic disks to increase speed; allows the use of "scratch pad" memory to increase efficiency; the bank select features give you high speed data handling and manipulation; and provide for multi user capabilities.

Super 89 Electronic Disk

This optional software package for the Heath/Zenith CP/M 2.2.02 and 2.2.03 allows the Super 89 user to access auxiliary RAM as a very fast mass storage device. Provides up to 180K bytes of storage area that is accessable without the slowness of disk drives. The Electronic Disk also includes display capability for the Real Time Clock.

Peripheral Expansion

This important feature lets you use your Super 89 in more ways with peripherals from DG, Heath and many other manufacturers. Some of these important enhancements are: Additional floppy disk controllers; Modem or Printer serial interfaces; Color video controllers; IEEE 488 BUS for test equipment and measuring interface; Analog/Digital interface; Parallel interface for high speed printers; Hard disk system controllers; Bread-board development cards; Computer game controllers; and Production process controllers.

Enhanced Super 89 Monitor

Gives you all the features of Heath's MTR-89 monitor plus the ability to display all the Z80 register contents; Single-step through a program and set up break-points; Supports H/Z and other manufacturers of disk systems; Improved system diagnostic routines; and Supports the Super 89 Real Time Clock.

Real Time Clock

The Real Time Clock allows you to program activities and control functions according to time; allows the use of interactive time functions with an electronic disk; and is very useful in accounting functions.

Parity Checking

This features ensures the integrity of memory transfer operations. The Super 89 alerts you if a parity error occurs.

Full CP/M and HDOS Compatibility

The Super 89 has full compatibility with either the HDOS or CP/M disk operating systems that does not require hardware modifications. This feature gives you the best of both worlds in the amount of existing software you may use.

Arithmetic Processor Provision

The Super 89 has on-board provisions for the optional AM9511A. This is a separate processor that features basic arithmetic as well as exponential, logarithmic, trigonometric and binary functions. Calculations are high speed and can be accomplished as a "hardware subroutine". This device is a must for anyone using any amount of mathematical computation whether complex functions or arithmetic calculations.

Ease of Installation

The Super 89 is simple to install and takes only minutes. No soldering required. Simply remove the old CPU board, configure and install the Super 89 to multiply the capabilities of your H/Z 88-89.

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CIRCLE #304 ON READER SERVICE CARD

Subroutine	A	B
Character Sort,1 char/record	.0013	0.081
Character Sort, 16 chars/record	.000986	1.28
Character Sort, 24 chars/record	.000983	1.92
Numeric Sort, 16-bit integers	.0022	0.268
Numeric Sort, 32-bit reals	.00717	0.509
Numeric Sort, 64-bit reals	.0148	0.835

These coefficients may be used to compute approximate sort times on a 2MHz H8 as follows:
Character Sorts
Time in seconds = (A × [NO_OF_RECS × CHARS_PER_REC]) + B
Numeric Sorts
Time in seconds = (A × NO_OF_RECS) + B

How fast are other sorts?

As we have seen, the sort time equation for an address sort is a linear function of the number of records. Now let's look at the sort time equations for quicksort and the bubble sort.

The bubble sort algorithm consists of two loops nested one within the other. Each loop is executed once for each record in the list being sorted, as follows:

```
Loop 1: for I_RECORD = 1 to NUMBER_OF_RECORDS
          :
  Loop 2: for J_RECORD = 1 to NUMBER_OF_RECORDS
            :
  end loop
end loop
```

The time for each loop is:
T1 = NUMBER_OF_RECORDS × t1
T2 = NUMBER_OF_RECORDS × t2

However, since the inner loop is nested within the outer loop, the time for one pass through the outer loop (t1) includes the *entire* time to execute the inner loop (T2):
t1 = T2 + K
where K is the time to execute things in the outer loop that are not part of the inner loop.

When the outer loop is finished, the sort is completed. Thus, the total sort time (T) is equal to the time to execute the outer loop (T1).
T = T1, or
T = NUMBER_OF_RECORDS × t1,or
T = NUMBER_OF_RECORDS × (T2 + K)
Recalling that T2 = NUMBER_OF_RECORDS × t2, gives
T = NUMBER_OF_RECORDS × (NUMBER_OF_RECORDS × t2 + K)
or
T = (t2 × NUMBER_OF_RECORDS^2) + (K × NUMBER_OF_RECORDS

The constants t2 and K may be renamed A and B to give
T = (A × N^2) + (B × N)
where N is the NUMBER_OF_RECORDS.

By similiar analysis, the sort time equation for

quicksort is found to be
$T = (A \times [N \times LOG(N)]) + B$

Why is an address sort the fastest sort possible?

Comparing the above equations shows the quicksort is slower than an address sort by a factor of LOG(N). The bubble sort is slower than an address sort by a factor of N, and slower than quicksort by a factor of N/LOG(N). Implicit in such a comparision is the assumption that the A and B coefficients are about the same in all equations.

The A and B coefficients in all of the the above formulas are different, since they represent different constant expressions. If small values are selected for the bubble and quicksort coefficients, and larger values are selected for the address sort A and B constants, the bubble and quicksort equations will yield faster times than the address sort for small numbers of records. For larger numbers of records, however, the N^2 *and* $N \times LOG(N)$ terms dominate the A and B coefficients, as the time grows more rapidly with additional records. The linear nature of the address sort time equation is not subject to such exponential growth. Therefore, there will always exist a crossover point in the number of records, above which the address sort will always have the smallest time. Thus, the address sort will always be the fastest for "large," i.e., beyond the crossover point, numbers of records, while below the crossover point, the bubble and quicksort will be faster than the address sort. This is the conclusion of mathematical theory.

How fast is the address sort compared to the others in practice, i.e., where is the crossover point? In an effort to answer this question, bubble and quicksort times were taken from reference 1 and adjusted for implementation differences. Times for these two sorts were then computed for comparison against the address sort H8 measurements. These results, which are for sorting 16-bit integers, are tabulated below. A graphical plot of the tabulated values is shown in Figure 1.

It is. . . ironic that, in their search for greater sorting speed, the computer geniuses of our day missed the fastest sort of them all by ignoring the ubiquitous!

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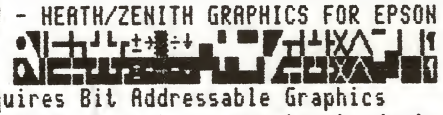

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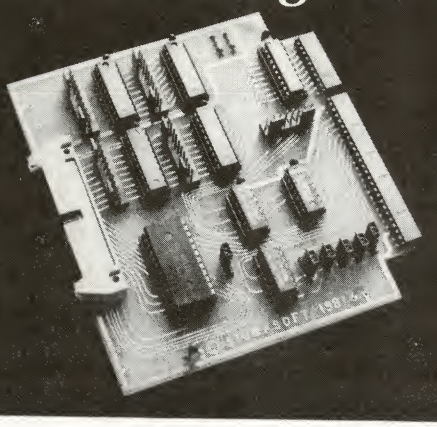

A Universal Parallel Interface for the H89/Z89

The SigmaSoft Universal Parallel I/O Board, probably the most versatile parallel interface yet available for the H89/Z89 computer. This board provides eight new ports, each of which can operate a separate device bidirectionality. These ports are provided in two different formats, for interfacing flexibility. So, whether you're interfacing a printer, or special devices requiring multiple ports, this interface is probably just what you need.

The board connects to any of the three slots at the left side of the H89/Z89 computer, and the port addresses can be positioned at any eight port address boundary (000-377Q), with the on board jumpers. Two of these ports are then buffered further, for use as full Centronics style parallel interfaces, or for up to sixteen bits of data to control CPU and terminal logic board modifications (2/4 MHz Switch, etc.).

All inputs to the board are buffered to insure continued data integrity. Installation requires some soldering, but no modifications to the computer.

We also offer software support for HDOS, supplied on 5.25 inch single density diskette, and CP/M support will be available soon.

The UP: (Universal Parallel) device driver is an extremely versatile driver that will operate almost any printer with a Centronics style parallel interface (Epson, Okidata, C. ITOH, etc.). Special features include:

* Special SET options to configure printer handshaking format.
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Universal Parallel I/O Board	$120
Centronics Style Printer Cable (for Epson, etc.)	$25
UP: Device Driver	$10
EP: Device Driver (Requires Epson and Graftrax)	$20

Prices include shipping.

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CIRCLE #328 ON READER SERVICE CARD

Type of Sort	Number of 16-bit Integer Records: 10	100	1000	10,000
Bubble Sort	.99	8.7	778	77,800
Quicksort	.95	1.1	36	476
Address Sort	.29	.45	2.5	22

Sort Time, seconds

These results clearly show that the crossover point lies below 10 records. These results apply only to the H8. However, it is my own belief that the crossover point will be reached quickly regardless of implementation, making the address sort the fastest for virtually *all* numbers of records, large and small. I defer absolute proof of this to the test of time.

Moreover, mathematics tells us that linear time algorithms are the *fastest that can be achieved.* Therefore, mathematically, the address sort is the "ultimate" sort, i.e., for large numbers of records, *no* sort can be faster. Ever!

What of other linear time sorts? The address sort is the only linear that I have been able to find. However, should another be discovered someday, it would then come down to differences in the A and B coefficients, and the results would probably vary with implementation. Mathematically, the two sorts would be equal as they would both be linear time. The contest would, in effect, be a battle between "supermen"—spectacular but inconclusive.

Applying the address sort

Since the address sort is the fastest possible sort, one may be tempted to conclude it is the best sort for all applications. Unfortunately, this is not the case, as the address sort does have a drawback which can impose limits on its application. This drawback is its memory requirement.

Recall that the address sort requires five arrays:

1. INPUT_DATA (number_of_records)
2. INPUT_ORDER (number_of_records)
3. SORT_PRIORITY (256)
4. COUNTER (256)
5. OUTPUT_ORDER (number_of_records)

All sorts require an INPUT_DATA array, and many of the more modern, faster sorting techniques use an INPUT_ORDER array in order to avoid juggling the INPUT_DATA contents. However, only the address sort uses all of the other arrays.

The SORT_PRIORITY array provides a degree of sorting flexibility seldom found in other sorts, but at a cost of 256 words. The COUNTER array, essential and unique to the address sort, requires another 256 words. However, the 512-word impact of these arrays is minimal compared to the size of the OUTPUT_ORDER array.

An unfortunate consequence of Step 4 of the

address sort algorithm is that the new sorted order cannot be returned in the INPUT_ORDER array; hence, the large OUTPUT_ORDER array is needed. I personally have spent many hours trying to figure out ways to eliminate this array without introducing nested loops (which would destroy the linear sort time), all to no avail. Because of this array, the address sort requires at least twice the memory of other sorts that use only an INPUT_ORDER array. Thus, one pays for the address sort's speed with additional memory.

Two facts, then, govern the proper application of the address sort. First, the address sort can be used to most advantage when the number of records is very large. Second, it will require more memory than alternative sorts. Consequently, the address sort is best for large sorting jobs on large-memory systems. For example, an address sort is

The address sort algorithm.

The address sort computer algorithm consists of four steps.

1. Zero the COUNTER array.
2. Count the number of records of each data value in INPUT-DATA. Use the COUNTER variable assigned to the data value by SORT-PRIORITY.

```
1     for RECORD = 1 to NUMBER-OF-RECORDS
2         DATA-VALUE = INPUT-DATA (RECORD)
3         SUBSCRIPT = DATA-VALUE + 1
4         COUNTER-LOC = SORT-PRIORITY (SUBSCRIPT)
5         COUNTER (COUNTER-LOC) = COUNTER (COUNTER-LOC) + 1
6     end loop
```

Note that in lines 3 and 4 the data value is used as a subscript to locate its own COUNTER location. The technique of using a data value as a subscript to reference other data is called "hashing." Hashing has the advantage of being very fast, and is often used in situations where speed is important. For example, hashing is frequently used in data management systems as a means of achieving high data retrieval speed. An address sort is a hashing-based sort, which partially accounts for its high speed. Also, the name "address" sort implies that data values are used as subscripts, i.e., address references.

3. Sum the COUNTER values to obtain the start address of each data value in sorted order.

In this step, a simple count of the number of records of each data value is transformed into the address of each data value in sorted order! Such a transformation is possible because of the definition of the COUNTER array:

COUNTER (1) = number of data values of 1st sort priority
COUNTER (2) = number of data values of 2nd sort priority, etc.

That is, COUNTER contains the number of each data value *in sorted order.*

We know that the data value with the highest sort priority, represented by COUNTER (1), come first. Therefore

$$\text{COUNTER}(1) = 1.$$

We also know how many of these data values there are, since we counted them in Step 2. Let's say there are N of them. The data value with the second highest sort priority, represented by COUNTER (2), must therefore start at address 1 + N, or

$$\text{COUNTER}(2) = 1 + N$$

or, equivalently

$$\text{COUNTER}(2) = \text{COUNTER}(1) + N$$

since COUNTER (1) = 1.

This reasoning leads to the following transformation algorithm.

```
1     DATA-COUNT = COUNTER (1)
2     COUNTER (1) = 1
3     N = DATA-COUNT
4     for LOC = 2 to 256
5         DATA-COUNT = COUNTER (LOC)
6         COUNTER (LOC) = COUNTER (LOC-1) + N
7         N = DATA-COUNT
8     end loop
```

4. Rearrange the INPUT-ORDER pointers to reflect the new sort sequence. Store the rearranged pointers in the OUTPUT-ORDER array.

```
1     for RECORD = 1 to NUMBER-OF-RECORDS
2         DATA-POINTER = INPUT-ORDER (RECORD)
3         DATA-VALUE = INPUT-DATA (DATA-POINTER)
4         SUBSCRIPT = DATA-VALUE + 1
5         COUNTER-LOC = SORT-PRIORITY (SUBSCRIPT)
6         START-ADDR = COUNTER (COUNTER-LOC)
7         OUTPUT-ORDER (START-ADDR) = DATA-POINTER
8         COUNTER (COUNTER-LOC) = COUNTER (COUNTER-LOC) + 1
9     end loop
```

Notice the similarity to Step 2, i.e., in lines 4 and 5 hashing is again used to reference COUNTER, which now contains start addresses for the sorted data. In line 7 the INPUT-ORDER data pointers are relocated to OUTPUT-ORDER based on these start addresses. Each time a data pointer is relocated, COUNTER is incremented to point to the next free address (in line 8). On completion, OUTPUT-ORDER contains pointers to INPUT-DATA for the new sorted order:

OUTPUT-ORDER (1) = pointer to 1st data record in sorted order
OUTPUT-ORDER (2) = pointer to 2nd data record in sorted order, etc.

ideal for business or other data base management sorting where large lists of names, products, etc. are involved.

The large memory spaces of the new 16-bit processors are made-to-order for the address sort. Ironically, most manufacturers are building 16-bit systems around chips with 1 to 16 megabyte capacity, but limiting the system's memory to 256K or 512K. The usual explanation is that no business application will ever need more than 256K. Applying the address sort to a large business data base could easily break the 256K assumption, and the short-sighted manufacturers along with it. It is to Heath/Zenith's credit that the Z100 series takes full advantage of its entire one megabyte address space. Thus, Z100 sorting applications can take full advantage of the world's fastest sort, and leave the competition behind.

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CIRCLE #323 ON READER SERVICE CARD

References

Sort time information for Bubble and Quicksort from:
"Sorting Techniques Explained," by H.S. Gentry *Kilobaud Microcomputing*, November 1981, pp. 156-160

ADSORT Subroutines for H8 and H/Z89

Microtran has developed a FORTRAN-callable subroutine library based on the address sort for the Heath H8 and H89. Written using Microsoft FORTRAN under the Heath Disk Operating System (HDOS), the library contains subroutines for sorting character (ASCII), integer, real, and double precision data. Also included is a stand-alone "SORT" program which demonstrates the use of the lilbrary. The documentation and commented source code are intended to allow a thorough understanding of all parts of the package. The documentation goes beyond the information contained in the article, and can serve as a detailed "coding specification" for those wishing to implement this new sort in languages other that FORTRAN, or on machines other than the H8 and H/Z89. The "ADSORT" package, which comes on two H17 5¼" hard-sectored disks, is available from Microtran, 76 Flintwell Way, San Jose, CA 95138. Cost is $29 plus $1 shipping (CA residents add 6.5% tax).

Example of an address sort.

The following example illustrates a two-column address sort for five data records (INPUT-DATA (5), INPUT-ORDER (5), OUTPUT-ORDER (5)) with a data value range of 0 to 3 (SORT-PRIORITY (4), COUNTER (4)). SORT-PRIORITY is set for a descending sort. Array values which change during a step are underlined with a "***" symbol.

Sort 1's Column:

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	1	1	4	x	x
Array Start Values	30	0	2	3	x	x
(INPUT-DATA =	3	3	3	2	x	x
1's Column)	33	3	4	1	x	x
(Start Pass 1)	2	2	5	***	x	x
		***	***			

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	1	1	4	0	x
Arrays After Step 1	30	0	2	3	0	x
(Zero COUNTER)	3	3	3	2	0	x
	33	3	4	1	0	x
	2	2	5		***	x

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	1	1	4	2 = 3's	x
Arrays After Step 2	30	0	2	3	1 = 2's	x
(Count Data Values)	3	3	3	2	1 = 1's	x
	33	3	4	1	1 = 0's	x
	2	2	5		***	x

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	1	1	4	1 = 3's adr	x
Arrays After Step 3	30	0	2	3	3 = 2's adr	x
(Perform a Sum to	3	3	3	2	4 = 1's adr	x
Get Start Addr)	33	3	4	1	5 = 0's adr	x
	2	2	5		***	x

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	1	1	4	1	3 = 3
Arrays After Step 4	30	0	2	3	3	4 = 33
(Rearrange Pointers)	3	3	3	2	4	5 = 2
(End Pass 1)	33	3	4	1	5	1 = 21
	2	2	5			2 = 30
						***

Sort 10's Column:

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	2	3	4	1	3
Array Start Values	30	3	4	3	3	4
(INPUT-DATA =	3	0	5	2	4	5
10's Column)	33	3	1	1	5	1
(Start Pass 2)	2	0	2			2
		***	***			

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	2	3	4	0	3
Arrays After Step 1	30	3	4	3	0	4
(Zero COUNTER)	3	0	5	2	0	5
	33	3	1	1	0	1
	2	0	2		***	2

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	2	3	4	2 = 3's	3
Arrays After Step 2	30	3	4	3	1 = 2's	4
(Count Data Values)	3	0	5	2	0 = 1's	5
	33	3	1	1	2 = 0's	1
	2	0	2		***	2

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	2	3	4	1 = 3's adr	3
Arrays after Step 3	30	3	4	3	3 = 2's adr	4
(Perform a Sum to	3	0	5	2	4 = 1's adr	5
Get Start Addr)	33	3	1	1	4 = 0's adr	1
	2	0	2		***	2

		Input			Counter Array	Output
	User Data	INPUT DATA	INPUT ORDR	SORT PRIOR	COUNTER	OUTPUT DATA
	21	2	3	4	1	4 = 33
Arrays After Step 4	30	3	4	3	3	2 = 30
(Rearrange Pointers)	3	0	5	2	4	1 = 21
(End Pass 2 — Done)	33	3	1	1	4	3 = 3
	2	0	2			5 = 2
						***

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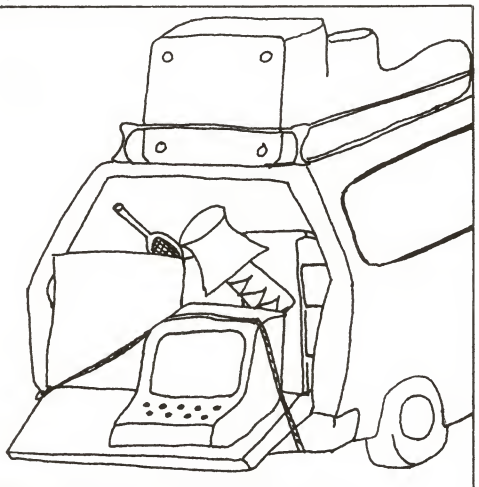

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How to Save Kilobucks with a Business Microcomputer

Don Carter

At our company, quite often we are asked whether a computer is cost-effective. We can only say that we have seen a number of businesses adopt computers, but have yet to see one which failed to lower operating costs. Most of these businesses had a number of repetitive operations in office work and an analysis of the company's needs was easy to form. But a few, including ours, did not have large payrolls or heavy check writing, and one did not have much of an accounts receivable problem since virtually all receivables were C.O.D.

So how do you determine whether you really need a computer? Well, the first sign may be when you find that you are spending more and more time on office work, perhaps even eating into your spare hours. Some tasks grow with a business, especially if there is a sudden increase of insistent customers. If this sounds familiar, then you are facing the same problems we had three years ago. One solution is to find an extra employee, perhaps on half-time. The other alternative is to purchase a computer. We discovered that there were a number of benefits from this choice and some of these were not anticipated.

Our firm's activities are more comparable to those of a sales and service store, or perhaps a professional business, rather than a major corporation. This is because the owner's responsibilities include the applications engineering of electrical and electronics projects on custom-built yachts. But the installation and repair of marine electronics equipment forms the major workload. All employees are hired on a contract basis. Business growth is supported by close liaison with boat builders, marinas and jobbers. Although this presents a somewhat different office work pattern than is usual, a change to a more typical organization would not have altered the office work a great deal. Therefore we consider that our experiences with a computer are pertinent to most small businesses which are demanding too much time of the owner.

Choosing Heath

Our first step was a study of the comparative expense of hiring a part-time office worker versus the cost of a modest but expandable computer. A year's half-time salary might be roughly comparable to half the initial outlay for a computer, but good equipment should last at least five years. And under the new regulations, it appears that your tax write-off can be based on either three or five years' life, depending on the computer's use. Together with investment credit, this forms a strong argument for the computer. The hidden cost of an extra employee may be offset by the cost of software. Our conservative estimate was that the computer would save us about $8,500 over a period of five years. Also we had to remember that labor and overhead costs are increasing, whereas the costs of computers, peripherals, and software are continuing to decrease.

No, no trouble–I can meet you at the club real early, say 2:30? Now that we are computerized, it's the staff that hustles all day.

An all-in-one computer has a number of advantages over the component type and Heath's H89 computer was just being introduced. It made an attractive choice since it could be supported by self-testing, factory liaison, and replacement plug-ins, as well as Heath stores. Its "smart" terminal with its own central processor unit (CPU) put it years ahead of the competition, and the documentation is near-perfect. And so we ordered an H89 with a single disk drive and H14 printer, adding two additional drives when they became available. It was a fortunate choice since it has operated for

two and a half years without a fault, even surviving two power interruptions! Some of this reliability may be the result of our housekeeping; more on that later.

If you examine the Heath catalogue, you will find that about $1,000 can be saved by ordering the kit instead of the fully assembled computer. There was also a big savings obtained by purchasing the printer in kit form at the same time. So we went the kit route. If you have an electronic hobbyist on your staff, one of those unique wizards who fall into the category of "you don't have to be crazy but it helps," then with his help you will probably have pleasure in building your own computer. You will learn all about precise soldering, identifying many hundreds of components and their unique markings, and a little about a computer. Alternately, if you don't have anyone with experience, but you do have a few weeks of spare time—about six to eight hours a day—then in two weeks you can develop the skill and precision of a watchmaker, the patience of a nurse, the self-denial of a monk, and if you can carry out thousands of technical maneuvers without making one mistake, you will finally turn on the computer without having it go "pfffffft."

But in truth, Heath finds that anyone who can follow instructions can build their kits. However, to follow these instructions (which are superb) without making an error probably requires that one should start with a simpler kit. It is easy to make some mistake like putting a condenser in backwards, which means a reversed polarity. That's just a simple error but it does considerable damage and it can be most difficult to find. And of course the soldering must be perfect. So the courageous person must obtain a magnifying lamp, an automatic temperature-controlled soldering iron, and lots of muffin tins to sort an estimated seven hundred parts. You must follow every instruction precisely and then double check. And be ready for a great deal of pride when the project is completed. If you do run into a problem, the amazing Heath Company will gladly fix it, or even finish the task if you grow faint-hearted. (For a slight fee, of course.) However, if you find the work pleasant and you are adaptable, then you will find that it is quite possible to "earn" $15 an hour for your spare time—which should make the task even more enjoyable.

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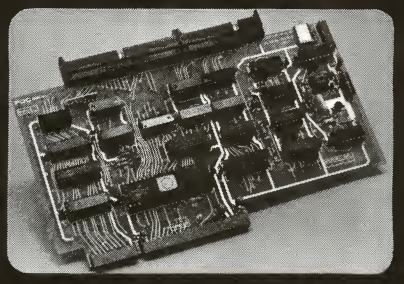

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After you've put it together

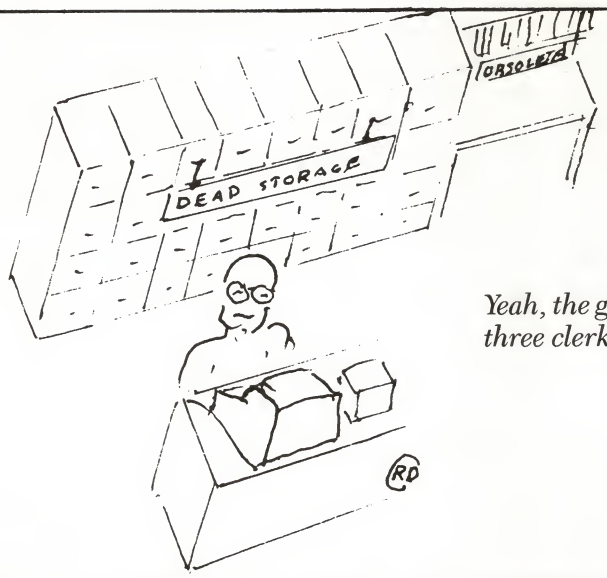
Plugging in a computer and turning it on the first time should be preceded either by a demonstration or by considerable study of the operating instructions and the documentation for the programs. Even demonstrations of other computers are quite useful. Also some skill at typing is a must, even if it is only hunt and peck. The manual explains disk operating procedures in detail, and the computer is quite forgiving of most errors. Especially in the Heath Disk Operating System (HDOS), errors result in a terse comment on the screen. But the physical portion of handling things is sometimes buried in detail, and a few warnings will be valuable.

The most obvious warnings concern the care needed in handling the disks, especially keeping the fingers off the plastic sections. And some of the loss of data on disks is the result of turning the power on or off with the disk in the drive, or removing the disk with the warning light on, or before the disk has been DISMOUNTed. Fortunately, most of these rules are as easy to learn as the first lesson in driving a car. During this period, as well as that following the introduction of a new program, my prime problem was to outwit my assistant, 50 years my junior and fast on the draw, in getting to the computer and the day's tasks. We found that the sense of working so efficiently, as well as achieving so much accuracy so readily, all tended to make this portion of daily work attractive.

The assistant found that the speed of the computer matched his wits and finally a new sales firm lured him into a more complicated technical life. Perhaps a policy can be formed from this lesson; never put a technical wizard on computer operations!

Software

When the H89 was first introduced, there were few business programs available, and these



Yeah, the good old days are gone forever. I used to have three clerks here. Now I have to get my own coffee.

only from the Heath Users' Group (HUG) on diskettes. These did not quite fit our needs, so we bought Heath's self-study BASIC course plus two books containing business programs, as well as numerous back copies of computer magazines. With these, we whipped up programs which exactly matched our requirements. However, there is now a wide choice of excellent programs from Heath, HUG, and independent firms as well, so there is no need for a businessman to study programming. Instead, the new computerist should read part of the *Software Reference Manual* of the Heath Disk Operating System (HDOS). Especially read the System Configuration chapter, and the first part of the next chapter, General Operations. The first section of the Microsoft BASIC manual is also valuable. A knowledge of these will increase the usefulness of your computer. Then if programming seems interesting, you can adopt the methods we used—study and modify existing programs.

What it got us

The first savings in office time were achieved in making up regular billing statements to our customers. This cut rather tedious work down to the simple answering of questions. In a few moments out popped an itemized and totalled bill ready for mailing. Five days of work were cut down to a few hours and customers were pleased with the presentation and fuller details. Thousands of these statements can be stored on an initialized disk in the second drive, so another battle in the paper war is won.

Next was a business program which kept track of all accounts receivable and accounts payable, deductibles, capital expenditures, and depreciation. Bookkeeping services were no longer required, and annual tax returns were so simplified that charges were cut in half. Although this program turned out to be the least attractive one, there are more choices now in HDOS; and the CP/M operating system allows many programs written for other computers to be used on our H89. Some business managers may be reluctant to spend several hundred dollars on a program which cannot be really understood until it is put into use. But the prime advantage of investing in software is that knowledge is increased each time—this experience will be very valuable in selecting programs in the future. Comparisons can be made by purchasing the instructions and sample print-outs, before a program is purchased.

Our most useful and valuable program was for inventory records. It was delightful to have customers phone for price quotations and delivery information, and in a very few seconds answer every question instead of having to return their calls later. At first, many clients suspected that we just happened to have all the record books opened to just the right pages, but after a few such experiences they would finally ask whether we had a computer. Soon, because of their interest, we had to find a sales expert who would answer their detailed questions.

We also found that the computer decreased the amount of inventory and overhead. Purchase orders are printed out with the computer and records brought up-to-date. When stock became low on a fast-moving item, an alert showed up. Similarly, if movement became slow, the computer could show that there was overstocking with just two items in inventory! The computer could also be used to advantage when advance notice was given by factories of price increases or decreases. These signalled the advantages of heavier re-stocking or alternately, a selling campaign to dispose of stock at the old higher price.

The word processor software we use is Zenith Electronic Typing (known as AutoScribe when we bought it). It operates with HDOS and gives us a full screen editor plus right margin justification and more features than we will ever need. It is so simple to use the primary functions that only a half

hour of instruction is required for even a casual typist. The word processor is used when we write and record technical instructions to amend and augment manuals for shop use. Technicians are encouraged to use the computer, and are rewarded by giving them equal time after hours on programming or games. This application has grown and so releases the office from much tedious work, as well as improving the technical standards of the shop. Also there has been an improvement in cooperation between the shop and office.

Taking care of things

Earlier in this article, a reference was made to the fault-free operation of our H89. A lot of this is built-in, but part is the result of the controlled environment in our computer room. The first hazard is dust; cigarette smoke contains small sharp carbon particles which are just large enough to damage the disks and heads. Frequent vacuuming of the room is also necessary.

The next greatest hazard is power line transients. These can lead to any number of faults. However, there is a ready remedy: purchase a spike protector such as those advertised. Simply plug all computer and peripheral power leads into a multiple connector box and thence to the spike protector and the 115 volts AC. Transients should now be reduced to a safe level.

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Humidity is a great enemy of diskettes. The thin magnetic layers on each side of the disk can absorb moisture and then swell and shrink causing faults and the loss of programs or data. If the outside humidity can range from 30% to perhaps over 90%, then wide changes can also occur in the computer room. Try to find one of the small hygrometers used by museums to indicate humidity. If the humidity changes much outside of the 50% to 60% range, then it may be necessary to install a dehumidifier for the rainy season. Electronic components have shortened life in elevated temperatures and so we set our heating for 66 degrees Fahrenheit and the cooling for 78.

If it is impossible to meet these suggested controls, just provide the best conditions possible. Other computer systems are kept functioning in very adverse conditions. One firm has six computers scattered throughout their manufacturing plant. Another has its computer located right beside the doorway leading to a fiberglassing production line. Under these conditions, the equipment should be cleaned daily. Also back-up copies of every file must be made on a regular basis. Really expensive computers have their own filters and some their own air conditioners. Perhaps your technicians can improve the conditions around the computer.

Storage of disks is also important. They must be kept away from magnetic materials and in dust-free containers. The plastic containers called Library Cases will hold at least ten diskettes, open to form an easel, and close tightly. They should be stored vertically on non-ferrous shelves. Also, you will find it best to make up an index of disk numbers and their contents. Printouts of file names can be made off the disk and inserted in a loose leaf book. This may not look important at the start, but it is surprising how quickly the files increase until suddenly it becomes difficult to find what you are looking for, unless it is in an index.

Is it for you?

You are lucky if you are just now starting to use computers! Since the mid 70s, their design has gone through virtually three generations of tremendous improvements. Memory chips have become increasingly compact and power-efficient. Their reliability in comparison to their complexity is fantastic. The advances in disk drive design and the increase in stored memory capacity are similarly phenomenal. Software availability, particularly with CP/M, is a thousand-fold as great as it was three years ago! And during this time, the cost of the hardware has kept decreasing. So by investing in a microcomputer now, you will have equipment and peripherals which will outmatch those owned by firms who took the plunge several years ago. And if you use your computer wisely, it will, indeed, save you kilobucks!

Give Your '89 a Boot—Automatically!

Ray Albrektson

It is 2:03 a.m. You are supposed to be up and receiving some important data files from Oregon, where the cheap telephone rates have just gone into effect. Instead, you snooze blissfully on while in the background, your hitherto dormant computer blinks into life. Your H/Z89 automatically activates its booting sequence. It boots itself and runs a modem control program. It is standing by when the call comes through and your modem does its auto-answer stuff. After receiving the files, your '89 hums contentedly for a few minutes before switching itself off.

Far fetched? Not really! With the flip of a little-known switch on the main circuit board of your H/Z89, your computer can boot itself automatically when powered up! Just think what you could do automatically by having your computer boot itself after being turned on by a timer, such as the BSR System X-10 timer. Here's how to tell if your computer is equipped to do it, how to make the change, and some ideas for applying this capability.

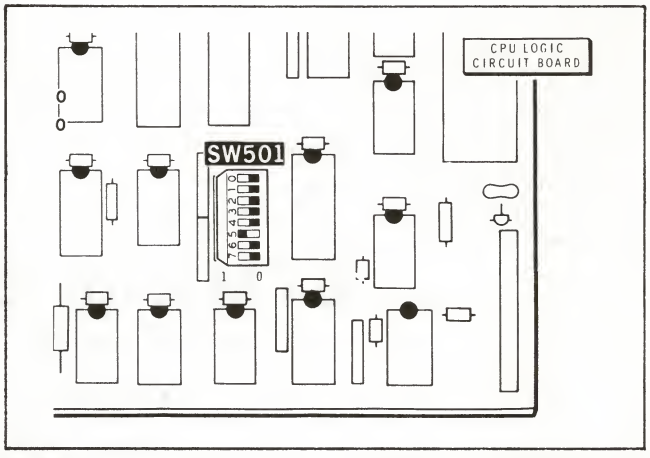
Can your '89 handle auto-boot?

First, you need to determine if your computer has a read-only memory (ROM) that has this "auto-boot" feature built in. The most direct way to find out is to open the top of your '89 and look at the device plugged into socket position U-518. This is a large, 24-pin ROM with a clear quartz window and a small paper sticker with the Heath part number written on it. If you have a 64K (or 56K) H/Z89, the ROM you are looking for is right under the small 16K memory board plugged into P503/P509. If you have a ROM with part number 444-62 or 444-84, great! If it says 444-40, you are out of luck. This last part number was the ROM that went into the early H89s and does not include the machine code for auto-booting. (You might want to consider ordering part number 444-84 from Heath.)

At the flick of a switch

If you have confirmed that you have an auto-bootable ROM, the next step is to set the switch labeled SW-501 so that the computer will boot when it is turned on. This switch is located on the main computer circuit board, and this is an easy way to find it: locate the bundle of red, orange, and black wire that comes from the power supply on the right side and plugs into the main computer board near the top at P516. Looking down from this plug, count off four integrated circuits until you come to an odd-looking device that is actually eight tiny switches.

These are the configuration option switches. They're numbered from the top down, beginning with section 0. Most of these switches will be set towards the right. S-5 (the sixth one down, remember) is set to the left position. If you are using 8″



SW501 is near the lower right corner of the forward H/Z89 circuit board.

disks, the top two or three switches may also be set to the left. The one we are interested in is S-7, the very bottom switch.

With the power off, very carefully reach down to that switch, and with a fingernail flick the bottom switch to the left. On power-up, your '89 inspects how this switch is set. Finding it in the left position, it will proceed to boot without waiting for the traditional "B" plus carriage-return.

Now to test it. Put an *expendable* bootable disk into the drive normally used for booting. Reach around and flip on the juice. Wow! The resulting burst of activity can make you leap like a startled gazelle if you are used to the more tranquil manual boot. If all goes well, your disk should boot right up to the DATE? request. If you now set the system to NODATE (by typing SET SY:NODATE), it will boot all the way up to the Heath Disk Operating System (HDOS) prompt. Since NODATE has to be recorded on the disk in order for auto-boot to be completed, you may want to have

some NODATEd disks set aside for auto-boot purposes.

A cautionary note

I also suggested that the disks be expendable. Why expendable? Well, the Heath designers, in their considerable wisdom, built this feature into the recent ROMs but decided not to "document" it in the Heath literature. This seems to mean that they can't guarantee that it will work correctly every time, or on every machine, or that something won't go wrong from time to time. It seems likely that their reservations about the "auto-boot" feature may stem from a deep-seated aversion to turning a computer on or off with a disk actually in the machine.

I auto-boot only with a duplicate disk, and keep the master safely tucked away in my disk file box.

The rationale for not inserting a disk until after power-up is simple. Every computer experiences a few milliseconds of temporary insanity as it goes from being an inert lump of components to a humming and cogitating computer. This is because the direct current power supply that feeds the computer takes a significant part of a second to build up its voltages from zero to five or twelve volts. As the voltage reaches a level where the circuitry begins to wake up, unpredictable things can happen. One of the things that the designers feared was that the computer might write some random bits to the disk drive in a fit of wake-up peevishness. Naturally, this could scramble a disk pretty thoroughly if the right sectors were savaged in this way.

So is it safe to auto-boot or not? There can be no definitive answer. I believe it is probably safe. The sequence of steps required to select and activate a drive and then write to the disk is long enough that it seems unlikely that it could happen by chance. In addition, the disk drive has its own DC power supply that has to get up and running, and any crazy instructions from the central processor unit would most probably find the disk drive in a state of confusion as well, so they wouldn't be acted upon.

However, there is no sense taking chances, and so I auto-boot only with a duplicate disk, and keep the master safely tucked away in my disk file box. I've never had a disk damaged yet, but I don't want the first time to be with an important disk.

Making it more convenient

One disadvantage with simply flipping S-7 on the configuration switch is that the computer will boot itself willy-nilly whenever it finds itself back at the monitor level. Every time you say BYE, HDOS will reboot from the disk that's already in the drive. Not very convenient! It means you can't use the monitor, and you can't do a "cold boot" without switching the

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computer off! If you don't use auto-boot that much, you just have to flip S-7 back the other way. If you use auto-boot a lot, however, it can get to be a nuisance.

Well, a solution exists — but only for the bold. It requires soldering a switch in parallel with S-7 on SW-501 and running it to a more accessible place so that it can be easily switched back and forth between auto-boot and normal. Here is what will be needed:

1. A length of twisted two-conductor wire, about 18" long.
2. A single-pole single-throw (SPST) switch, either toggle or push-on push-off, such as Radio Shack 275-617.
3. Soldering iron, solder, wire cutter, and strippers, etc.

Here is how to go about adding the switch:

1. Unplug the computer!
2. Carefully remove the accessory boards from the main computer board and lay them in a safe place.
3. Remove the two sets of connectors at the top left of the main board as well as the power plug (P516) and tuck them out of the way.
4. Unscrew the two screws that hold the main board in place in the computer.
5. *Gently* lift up the main computer board, and unplug the final plug from the bottom right as soon as it can be reached.
6. Lay the main computer board down on a soft surface, such as a folded towel, and locate SW-501 from the reverse side of the board.
7. Carefully solder the pair of twisted wires to the bottom set of contacts of SW-501.
8. Put the main board back in place so that the twisted pair goes down and under the main board, coming up into the central interior space of the H/Z89. Connect the plug into the bottom right as you do so.
9. Route the twisted wire pair to the right so that it exits the computer between the disk drive and power supply. This point of exit is probably as good a place as any to install the switch.
10. Drill a hole, appropriate to the switch you have, through the structural foam about six inches forward from the back right edge of the base of the H/Z89. Be careful not to overheat the foam if you use an electric drill. Very slow speeds, even a hand auger, will work well.
11. Connect the switch to the pair of twisted wires from the main computer board.
12. Put in the main circuit board retaining screws, plug in all plugs, and reinstall all accessory boards.

The modification is done, but the Moment of Truth remains. Will it work? First, make sure the newly added switch is "open" (use an ohmmeter to test, if possible), and that S-7 of SW-501 is in the normal position to the right. We want the computer to be completely "stock" for the first test. Plug it in and turn it on. Does everything seem normal? It should! After booting a disk normally and giving the computer a general check out, turn it off. Switch the new switch to the closed setting, which we will now call the auto-boot setting. Apply power. Does it boot? Well, what do you know, it does!

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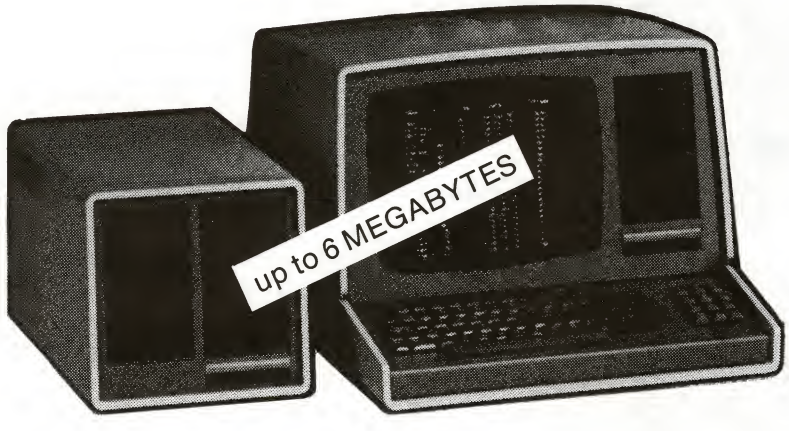

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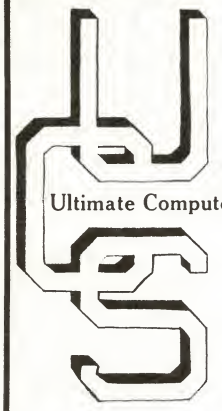

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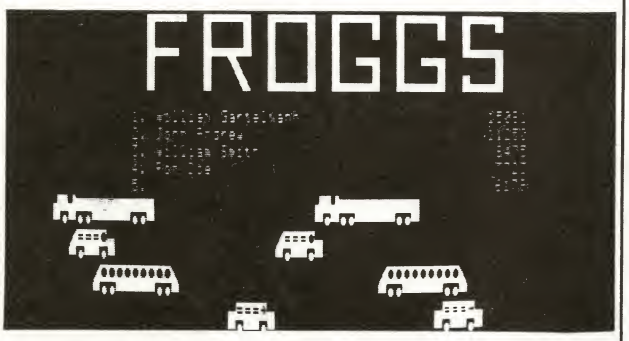

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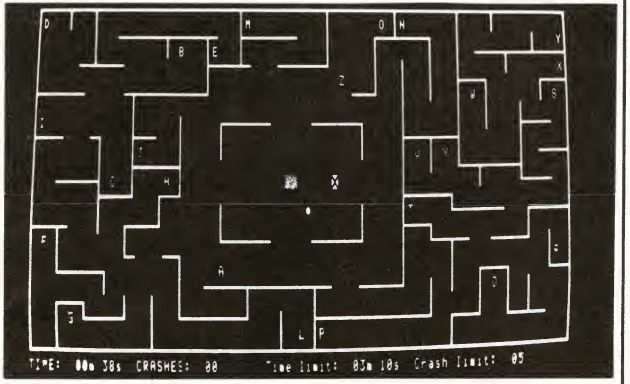

CAN YOU HANDLE THE CHALLENGE?

CIRCLE #322 ON READER SERVICE CARD

Putting it to work

How do we put this nifty feature to work? One of the most elegant solutions is to use the BSR System X-10 timer to turn the H/Z89 on and off. With the '89 plugged into an Appliance Controller, the X-10 timer can control the '89's turn-on and turn-off times with great precision. The example of remotely receiving or sending data at pre-arranged times is only one possibility. It can be done via BSR timer and an auto-dial, auto-answer "smart" modem. Using a recently introduced BSR Telephone-Actuated controller, you could activate and boot your '89 from anywhere in the world! Add voice-recognition (or touch-tone decoding), and any telephone can become a remote extension of your H/Z89.

If the H/Z89 has a real-time clock, the system can check the time and perform different operations depending on the time and date. For instance, the X-10 could wake the system up at 6:30 in the morning. The computer boots itself and checks the time. Since it is between 6 and 7, the computer realizes that it must go through its "get the operator up" sequence. It utilizes its own BSR controller to turn on the coffeepot. It checks the date and runs an executive appointment program, printing a schedule of the day's events. The computer turns on the electric heater in the bathroom. Promptly at 6:50 the computer turns on the radio by the operator's bed, and the day begins to a warm bathroom and hot coffee.

What if you use your computer to monitor your security and alarm system? In case of a power failure, you want your '89 to reboot, and pronto! A prologue program could reset the system, check for a break-in, and call the police if necessary.

The possibilities are limited only by our imagination and the software available. Imagination we've all got, and software to do this sort of thing is available at modest prices. One program effectively substitutes a disk file for the console keyboard so that a program can be run, necessary commands to the program provided, etc., without any operator intervention. This HDOS enhancement package is available for $35 from T&E associates, Inc., P.O. Box 362, Millersville, MD 21108. A little known fact is that any machine language program can be renamed PROLOGUE.SYS and the Heath DOS will automatically run it upon boot-up. One easy way to create these prologues is using SYSMOD2, an enhanced system command processor available from Jim Teixeira, Soft-Shop, 32 Shadow Oak Road, Sudbury, MA 01776 for $17.95.

One hardware accessory that dovetails neatly with an auto-booting H/Z89 is a clock. Several good ones are on the market. The author has developed a clock board that includes a sound-effect generator that is available for $90 postpaid, with software for HDOS on a 5¼" hard-sector disk. Order from H/Z89 Clock-Sound, Box 2116 A, San Bernardino, CA 92405.

Is auto-booting for you? It opens up wide vistas of new applications at only slight risk. At least give it a try—flip that switch today, and decide for yourself.

Budget Word Processing: A Followup

Hugh Kenner

Some months ago the Software Toolworks and I went into interactive mode, my "Budget Word Processing" article in *Sextant* #1 having triggered an advance copy of TEXT 4.0. This newest version not only eliminates the few defects I complained of there but boasts such a cornucopia of new features it deserves a followup report.

To no one's surprise, the pre-release version had bugs. That is why sensible software vendors send out advance copies. Bugs are much less hard to fix than they are to find, and the more users, doing diverse things, the better the chance of finding some. One that turned up was so finicky you could make it recur only if you started a "Comment" line at the second tab stop, and moreover made the Comment just *x* characters long. Yes, it got fixed.

A later day's mail brought a formally packaged release copy: TEXT 4.0, by Dr. Jim Gillogly, from The Software Toolworks, 14478 Glorietta Drive, Sherman Oaks, CA 91423; or see your Heath or Zenith dealer. If you already have an earlier version, $12 brings you the update. The one bug it contains that I know of should be gone by the time you read this.

At $39.95, its price is up 14%, a rate to balance against the increase in its usefulness—I'd put that at maybe 200%. The Toolworks is counter-inflationary. At under $70, PIE plus TEXT 4.0 is a Word Processor to weigh seriously even if you'd not think $250 unreasonable.

I complained last time about TEXT's opaque documentation. I complain no more. With TEXT 4.0 comes a 65-page package (produced with TEXT) which is a model of what documentation should be, and a credit to its author, Marrietta Gillogly. You are led by the hand in clear English through every command with helpful examples. You are given a pre-recorded practice file to learn on. You are shown, moreover, model files like a Form Letter formatter. For clarity, for foresight, for avoidance of jargon and ambiguity, in the difficult field of microcomputer writing I have seen nothing to equal these pages.

To the program. Readers of my previous article will remember that PIE is an editor, to get it in; TEXT a formatter, to print it out. So what will TEXT do now that it wouldn't do before?

Embedding reference notes

Most spectacularly, it will put things on disk for later retrieval. For instance, you can embed reference notes in your text as they occur, for printing all together at the end. I do this as follows with each "catchword" I wish to reference:

.wf notes
p.\#, "catchword": text of note.
.sp
.we

When the file is being printed, everything between ".wf" and ".we" is skipped by the printer; it gets written instead on a disk file called "notes", which simply grows longer as more notes are added to it. At file's end a single command, ".rf notes", prints the notes in order, separated by the blank lines ".sp" creates. "\#" puts into the "notes" file the number of the page on which the note occurred, so they get printed thus:

p.23, "catchword": text of note.
p.25, "catchword": text of note.
etc.

If later I insert or delete enough lines to throw the page numbering out, the next time the file passes through TEXT all the numbers get automatically revised. Yes, doing it this way means there is no indication on the page that my "catchword" has been referenced in the notes at the end. I could use superscript numbers (see below), but at present I prefer the freedom of being able to add notes or cancel them without need to renumber.

For clarity, for foresight, for avoidance of jargon and ambiguity, in the difficult field of microcomputer writing I have seen nothing to equal these pages.

Another thing you can do with ".wf" is record the inside address on a letter for reprinting on the envelope. Still another is assemble a Table of Contents. I do that with ".wf SY0:contents", specifying SY0: so that no matter how many outboard disks my text may be drawn from, all of the "contents" file will end up in one place. So at the beginning of each chapter, TEXT encounters this:

.wf SY0:contents
.tc "[chapter name] "." \#"
.we

There "\#" once again picks up the current page number. At the end of the whole job, ".rf contents" prints the table.

It looks like a table thanks to the new command, ".tc", with the aid of which TEXT reads a file like this:

.tc "Chapter 1 "." 3"
.tc "Chapter 2 "." 21"
.tc "Chapter 3 "." 45"

and puts it into this format on the printed page:

Chapter 1 3
Chapter 2 21
Chapter 3 45
etc.

In this case, you can see that the quotation marks are not part of my text but act as delimiters required by the ".tc" function. The first quotes enclose words to be printed flush left, the second ones words to be printed flush right. The character in the middle (a blank if you like) gets repeated across the gap. Any of these three fields can be left empty, so the quick way to draw a margin-to-margin line is

.tc "" _ ""

and the quick way to print the word "Sextant" flush right is

.tc""""Sextant"

Underlining

Another new feature is the in-line underline command. TEXT still responds as before to the commands ".ul" and ".cu" for word-by-word or continuous underscoring respectively, and expects what will follow the command to be on a

new line. Such commands are troublesome when you want to underline a word but not the comma after it; the only way is to backspace before the comma. We now have recourse to \{words words\}, which underlines all the words it encloses but not the spaces between them, or \[words words\], which does the same but keeps the underscore unbroken. Snuggle either of these next to a punctuation mark and get no unwanted spaces, no underlined commas and periods.

You can embed reference notes in your text as they occur. . . .

For good measure, \<words\> will embolden the enclosed portion by overtyping it once. A preliminary ".bn q", where "q" is any number, makes the emboldening process overtype not once but "q" times, a useful feature if your ribbon is tired.

Some other matters

I mentioned a bug, and it's this. If, while underlining in response to one of these new commands, it encounters a page-break and header, then in the heat of processing the header the copy of TEXT 4.0 I am using loses track of its obligation to underline, and does not resume. This bug has now been removed from TEXT 4.0; but if you got a very early copy, you might want to check for it.

You may wonder if, just for symmetry, \(character\) has a use. It has. It marks off "zero-width strings", which will do whatever they're supposed to while being treated by TEXT's formatting calculations as though they weren't there. For instance, if a line is being centered, or the right margin is being justified, TEXT's arithmetic will ignore whatever is between those parentheses. This is useful to keep characters that won't get printed anyway from messing up the formatting. Such characters include the Escape codes that make the Diablo print superscripts and subscripts. I'll now digress about those.

Thanks largely to the near-impenetrability of the booklet that comes with the printer, many Diablo owners are unaware of Escape codes. *Escape D* rolls the carriage down (hence the character up) half a space; behold, a superscript! After that, *Escape U* does the opposite to regain the normal line. To get a subscript, as in H_20, you'd use them in the opposite order. Contrary to what the Diablo book seems to be saying, the "D" and "U" must be uppercase. Now, how do you put those codes into a file?

In PIE, CTRL-K makes the character that follows it into a non-printing control code. CTRL-K ESC (use the Escape key) puts a [on the screen in *reverse video*, but it won't print as a bracket, in fact won't print at all. It will merely say "Escape" to the printer, which then awaits the next character to learn which Escape is in question. If the next character is a D, it too will not print; it will be an Escape D, and the printer will accordingly roll the paper down half a line. Anything you print after that will be half a line up: superscripted.

It is those Escape codes that you want TEXT not to be confused by when it is filling and justifying, and you achieve that end by enclosing them between \(and \).

With automation and hyphenation, too

That entails a lot of keystrokes, and if you'll be doing it more than two or three times per file, it will get so tedious and error-prone you'll want to use the DO function of PIE to automate it. The DO key is the one with the blue square. To experiment, start a PIE file, trust me, and copy the following (don't type spaces; and "DO" means "hit the BLUE key"):

ENTER DO \(CTRL-K ESC \) D x \(CTRL-K ESC \) U DO

If you did that right, you should now be looking at

\([\)Dx\([\)U

with the each "[" in *reverse video* and the words "Recording completed" on the screen's bottom line.

If you printed that string, the "x" would be superscripted. Now for the duration of work on this file, one press of the DO key will oblige with the entire package wherever a superscript is needed. After pressing "DO", just overwrite "x" with the numeral you want.

All well and good, but whenever you exit PIE the DO key's memory goes blank. What of a long job, where you'll not want to re-key that nonsense each time you resume work? That is the time to use TEXT's String Substitution facility, whereby the command

.sb d [string]

defines a string called "d" which the command

\sd

will then invoke anywhere on a line. You can have up to 26 strings, one for each letter of the alphabet, and you'd choose your letters for mnemonic value. So at the beginning of the file, just define "d" and "u" with the Escape D and Escape U sequences, and thereafter \sdn\su will give you a superscripted "n".

Finally, hyphenation. If a line ends with a raggedy space because the next word was a tad too long, you can hyphenate the troublesome word. TEXT will now break lines at hyphens when that's an efficient place to break them; if "cross-reference" came at the end of a line with between six and fourteen characters to spare, it would break at "cross-". Better still, TEXT now provides "soft hyphens", which are honored when useful and ignored when not. The "soft hyphen" command is "\-", and if TEXT encounters a word like

"pro\-cras\-tin\-a\-tion"

at line's end, it breaks the word at the most economical place and disregards all the others. Since you'll not want to soft-hyphenate every polysyllable, you'd type straightforwardly, inspect a trial printing, and insert soft hyphens judiciously into problem areas.

And some final comments

Two final notes. 1) Since *Sextant* #1, I've spent more time and money than I want to think of on following up a recommendation of Magic Wand. Don't. Not only is the Heath/Zenith version bug-laden and the manual a shambles, Magic Wand lacks an important capability which TEXT takes in stride: the ability to concatenate files simply. By stringing segments together with the ".rf" command of TEXT, you can print a manuscript of any length. Try *that* with MW.

And 2): the HDOS Diablo driver, LPH44, is primitive. Most users have learned with amazement that it does not even support the printer's bi-directional

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capability. Moreover, like an old Irishwoman muttering "don't bustle me", it hems and haws every few seconds on being confronted with a new disk sector to read. For $25, the Maxi-Print Device Driver, Model Diablo, from T & E associates, Inc. (P.O. Box 362, Millersville, MD 21108) solves your driver problems. You DELETE the LP: on your Word Processing Disk. You COPY LP:=DIABES.V20 from the disk they supply. You also copy SET.ABS from your HDOS source. You make the driver compatible with TEXT through the command SET LP: LENGTH 0,66. You are done. Bidirectionality, no routine bang of the carriage returning, no pause ever for disk read. Velvety.

The driver has a Typewriter Emulation mode, too. The command COPY LP:=TT: makes your keyboard drive the printer directly, almost like a Selectric except that at end of line you hit LINE FEED as well as RETURN. Getting out of this mode is the first use I've seen for the H/Z89's BREAK key.

Only one nuisance: to use this driver with any version of TEXT before 4.0, you should explicitly load it into memory with LOAD LP: or everything may lock up. T & E's Tom Cauthen blames a bug in TEXT. I've not asked TEXT's Jim Gillogly what he blames. With TEXT 4.0 the problem is gone, anyhow. With earlier versions, the result is worth the slight bother.

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CIRCLE #333 ON READER SERVICE CARD

Double-Precision Trig Functions

Hugh Kenner

```
10 REM: DOUBLE PRECISION SQUARE ROOT
20 DEFDBL W-Z
30 INPUT "NUMBER"; X
40 Z = SQR(X)
50 Y = Z
60 W = ((X - (Z * Z))/(Y + Z)) + Z
70 IF Y <> W THEN Y = W : GOTO 60
80 PRINT Y : GOTO 30
```

This uses a familiar iterative procedure. Starting (line 40) with the single-precision root ensures exit after at most three iterations.

```
10 REM DOUBLE PRECISION SINE (ANGLE IN DEGREES)
20 DEFDBL W - Z
30 INPUT "ANGLE"; X
40 IF X = 0 THEN GOTO 120
50 X = (90 - X) * 3.141592653589793#/180
60 W = X * X : I = O : X = 1 : Y = 1
70 Y = Y * W
80 I = I + 1 : Y = Y/I
90 I = I + 1 : Y = -Y/I
100 Z = X + Y
110 IF X <> Z THEN X = Z : GOTO 70
120 PRINT "SINE = "; X : GOTO 30
```

The Taylor Series, iterated until the last term is too small to make an observable difference. This version runs up to three times as fast as the seemingly equivalent "110 IF Y=O...."

For Cosine instead of Sine, change lines 40, 50 to
40 IF X=90 THEN X=0: GOTO 120
50 X=X*3.141592653589793#/180.

```
10 REM DOUBLE PRECISION ARCTAN (RESULT IN DEGREES)
15 DEFDBL X-Z
20 INPUT "TANGENT";X
30 Y=X
40 IF X>1 THEN Y=1/Y
50 Z=81
60 FOR I=40 TO 1 STEP -1
70 Z=((I*I*Y*Y)/Z)+((2*I)-1)
80 NEXT I
90 Z=Y/Z
100 IF X>1 THEN Z=(3.141592653589793#/2)-Z
110 PRINT Z*180/3.141592653589793# : GOTO 20
```

The series expansions I've encountered for Arctan converge too slowly to be useful. This 40-term continued fraction gets there in three seconds.

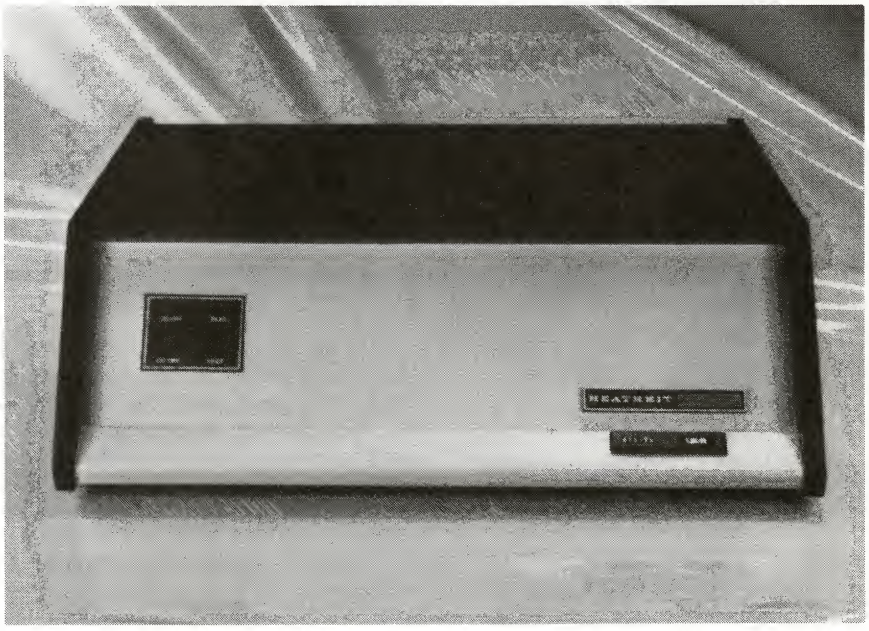
```
10 REM DOUBLE PRECISION TANGENT (ANGLE IN DEGREES)
20 INPUT "ANGLE"; X#
30 X# = (90 - X#) * 3.141592653589793#/180
40 SQ# = X# * X# : I = 0 : X# = 1 : Y# = 1
50 Y# = Y# * SQ#
60 I = I + 1 : Y# = Y#/I
70 I = I + 1 : Y# = -Y#/I
80 IF X# = X# + Y# GOTO 100
90 X# = X# + Y# : GOTO 50
100 A# = (1 - X# * X#) : G# = SQR(A#)
110 Y0# = G#
120 Y1# = ((A# - (G#*G#))/(Y0# + G#)) + G#
130 IF Y0# <> Y1# THEN Y0# = Y1# : GOTO 120
140 X# = X#/Y1# : PRINT "TANGENT = "; X# : GOTO 20
```

Public Domain Software for Your H11

Edward Judge

It seems that Heath has dumped the H11 computer. The price of a complete system (minus a terminal) had been down to about $2,600, more than a forty percent cut from what it would have cost if the components had been purchased separately. Now it's no longer in the catalog.

For those of you who could use the H11's power and adaptability, however, the price cuts preceding its passage made it a bargain. How much of a bargain? Well, with a disk controller such as the one from my company, Fairbrother Associates, you would have had an H27 disk drive equivalent to Digital Equipment Corporation's RX02 single-side/double-density disk drive. That would have given you the ability to move up to a double-sided drive. And it would give you as much as 375 blocks of electronic storage (512 bytes each) with our DY7: disk handler modifications and 256 kilobytes of memory installed. Not bad for a total of about $3,600 (plus as much more as you wished to spend for additional memory).



There's enough public domain software available to ensure that no H11 is merely a paperweight.

For those of you who are not familiar with the H11, it is a Digital Equipment Corporation (DEC) LSI-11 computer that Heath Company first packaged as a kit in 1977. The user assembles the power supply and other parts except for the actual computer boards. It runs the HT11 operating system, which is a much worked-over version of DEC's RT11-V2C operating system. There were all sorts of "hooks" put into the HT11 operating system that make you run Heath's peripherals or it crashes the system. This would have been O.K. except that the range of peripherals offered with the H11 was extraordinarily small.

First, there was a paper tape punch/reader, Heath's H10, that made a better anchor than a peripheral. (You needed the optional anchor package — basically a bag of cement.) Then Heath provided the H27, an 8" single-side/single-density (SS/SD) floppy disk drive. It offered a modicum of storage and is much more suitable for the H11's powerful 11/03 central processor unit (CPU).

This is where we are today, Heathwise.

There are, though, many after-market products for the H11, some of which are mentioned in this article. The key thing to remember is that the H11 is functionally the same as the DEC PDP-11/03 and can thus be upgraded to DEC's new 11/23. The 11/23 or 11/23+ is the equivalent of one of the most powerful and widely used minicomputers around, DEC's 11-34A. I am surprised, in fact, that the H11 did not become the flagship of Heath's computer line. It's a significant number-crunching business/scientific computer that should command more attention.

Of course, that also means that a lot of the best known software available for use on the H11 will come with prices that many Heath users will regard as steep. The H11, though, is a computer that serious hobbyists or business users can readily upgrade to meet increased needs. Just for general information, an 11/23 with Memory Management Unit can be gotten for about $1,000 to $1,400, depending on whom you know and how much of a deal you can get. At Fairbrother Associates, we sell a 256-kilobyte memory board for $900. (Remember what they cost nine months ago?) That includes parity, for memory error detection, when supported on the Q bus. Things will undoubtedly get cheaper, as the Japanese were recently getting set to ship 256K chips—although they may have to hold off because of bugs. Big disks and tape drives are getting cheaper, and a full reel-to-reel subsystem can be had from some sources for under $4,800. A 40-megabyte Quantum disk drive and all the parts needed to run it can be gotten routinely for $5,000 to $5,400. A 169 MB superfast Winchester with controller can be had for around $9,000.

How did I get here?

When I first started with my old H11, I had nothing but version 1 BASIC and a worthless (to me) FORTRAN. As I started collecting software and getting to know people, I passed on what I had and collected even more. It was beginning to get out of hand (I am disabled). So my girl friend, Judy Fairbrother, said she would take it over. So I organized the stuff as best I could and let her work it. Thus was formed Fairbrother Associates. Aside from software, we market, for instance, the only H27/RX02 controller board we are aware of.

H11 software for free (almost)

I have no idea where it will lead, but in the meantime, I've come across a lot of software for the H11. And a lot of that is in the public domain. Let's take a look at some of it.

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The **AR** or **XD** subdevice handlers are among those pieces of software that we use all the time. They are very useful for those of us who have large disks, but those with smaller storage (like the H27) can also use them to advantage. If you have a series of programs that are used together, a subdevice can be created to hold all of them in one place, and the directory only lists the subdevice name. This unclutters large directories, and keeps small files necessary for the program from being lost. It's a pity we haven't had these around longer. Several programs that could have been put in the public domain series were not because a small subroutine or documentation file was lost. Another useful feature of creating a subdevice is that the assignment program can read "DEV/FILES" files. These are image files of floppies or whatever that are created when PIP is used with the command format:

"COPY/DEV/FILES SRC: DST: FILE.NAM"

You merely assign FILE.NAM as a subdevice and read its directory, copy from or to it, delete from it, etc. With larger storage devices, it becomes essential. There are firms offering slightly fancier versions for several hundred dollars.

RTCON is another useful program. This is a pseudo-device handler that switches the console from one terminal to the other. Although we use the TSX-Plus operating system for time sharing and have terminals in different areas, I sometimes have to use the RT11SJ FORMAT program to reformat some diskettes, and would like the console to be next to the computer. I used to move the terminal from our office upstairs to the computer downstairs, and that was an obnoxious job. Now, with RTCON (renamed to RY.SYS) I just SET the console to the terminal downstairs and everything is ready to go. No more moving terminals. If we had had this before, I probably would not have gotten TSX until we had need for multiple simultaneous input. Our system is used by others only a few times a week now, and I could have just allowed them to use it and gotten back to what I was doing after they were through; but the ability to have terminals upstairs and down was becoming necessary. With RT.SYS, this capability can be had with the 11-03 and an additional serial port. The console is reassigned to any standard port. The sources allow you to change it to a non-standard port, or whatever. I don't have the time, but I wonder whether some quick-minded individual could put the technique used in this program to some innovative use in programming a multi-terminal monitor. SYSGENed monitors are always trouble unless you are scrupulous in maintaining your system. (You'll understand once you have messed around with non-standard monitors and handlers and seen the reply "MON-F-Conflicting SYSGEN options" a few times.)

SIGNON is another example of a simple program that makes things easier. There are two versions: the older one, which is much smaller and simpler; and the new version, which has more features but is much bigger (20 blocks). SIGNON asks for the date and time. The old one asks, and accepts, whatever you type in and attempts to set time and date with the information. No checking is made, and you can just CTRL C it to defeat its purpose. The new version also asks for date and time, but it checks the format and gives an error message and tells you to reenter until it is right. It cannot be gotten around with a CTRL C. If this program is in your indirect startup file, you cannot use your computer without entering the time and date. I know that many will say "so what?." But if you use your computer for more than games, the date is necessary to determine if this is the newest edit of a file. The time is used in the same fashion by the FORTRAN and Macro compilers. It can be very frustrating to have two long listings and not be able to tell which is the newer edit without close scrutiny. The time and date on the top of the listing does it for you.

UPDATE is a program from the Australian RT11 operating system Special Interest Group (RT SIG), part of the worldwide Digital Equipment Computer Users Society (DECUS). UPDATE maintains a comment directory file of any storage device. On a small device, the problem is not as acute, but it is still there — "What the heck does this file do ??!!" When UPDATE is run, it sees if any file on the disk is not in the directory. If it finds one, it prints the name of the file on the screen and asks you for a short comment or description of what it does. I wish I had used it earlier. There are several programs that are so similar that I cannot distingish between them, even after quickly analyzing the DUMP and DIFFERENCES printout. I named them differently, I assume, because they had different functions. Whatever the change was for, it escapes me now. On large devices, especially when other people can place files on them, it becomes a saving grace. I have re-done programs that were finished but forgotten. UPDATE helps you organize your files so you know what you have. I am sure that many conscientious people have nice systems involving hanging file folders, logs, or directory files laboriously maintained. I did, too, at one time, but let them lapse. UPDATE is the most painless way I have found, and I still mess it up once in a while. (I guess it's just me.)

LPOUT is a nice printer output formatter that can be driven from an indirect command file. It prints the page number and a single message line at the top of the page, and paginates for you automatically. It is written in FORTRAN, and sources are available, so it can be customized. It could also be linked with an overlay structure; and if it turns out small enough, could be linked for foreground operation. Just a thought, as I have not tried to do it, but it could be used with the FB monitor as a formatted spooler package.

(There are also several spooler packages available in the public domain series of disks, and one has encryption/

decryption capabilities. A business might find that useful.)

DSC is a standard utility and compares disk directories and will even run a compare on files to see if they are exactly alike. You tell it device 1 and device 2 and add some switches, and you can get a file of files common to both disks, and those unique to each. If you wish, the program will use BINCOM to check for an exact match. It can also be told to use the date as a criterion. There is not much to say about this program, but many people consider it one of the most important programs they have. It should be able to be used for a nice selective backup program.

EDS is a slow but nice word processor written in TECO. (That's Text Editor and COrrector. Unofficial and unsupported by DEC, it's a powerful text-handling interpretive language. And also unusually arcane.) Those of you who are familiar with TECO know that it means that EDS is S-l-o-w. But the price is right, and some of its features are great. It has a "see-all" mode where every character, printing or not, is displayed. It also has a command for putting a box of "*" around text. And it has the standard "auto-justify" mode, where the program formats and justifies on the screen as you type in the text, etc. I prefer KED/K52 and a good formatting program such as DPS or RUNOFF. But for those who would rather see the finished product on the screen, this may be the answer. Again, slow, but for the price. . . .

SYSAVE is a copying program with some very nice features. It will copy from any size directory structured device to another of different size. It can copy the files over alphabetically, or by any option that PIP allows, and will copy them for a best fit. If you are sending a lot of software and order doesn't mean much, it can save several disks with its "best fit" method. You assign the device you wish to copy from "IN" and a "COLUMN: 1" directory file is made, with whatever switches you wish. If you wish to copy over alphabetically, use the "/ALPH" switch, etc. Then SYSAVE asks you what to do. It will either initialize the device, setting VOLID and OWNER, or just "DEL DEV:*.*." Then it prompts you to change floppies or whatever. You can specify two output devices (DX0:, DX1:), as long as they're the same size, and it will automatically alternate between them. This is one of the ways I do the public domain stuff. I am now waiting for someone to implement this whole process as a ".SAV" file, as TECO makes it unnecessarily slow.

SPELL is a program from the United Kingdom RT SIG. It is written in Macro and is reasonably fast. It is not as flexible or as comprehensive as SPELL-11, but it works well for what it is. It comes with sources, a small dictionary, and has the ability to use up to five other dictionaries that you create for your own personal needs. I know many people who think the price/performance ratio is quite good.

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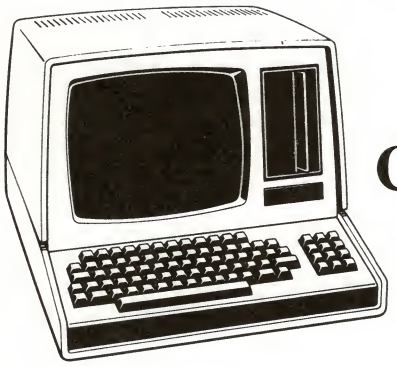

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CIRCLE #316 ON READER SERVICE CARD

(SPELL-11, with much nicer amenities and a 32K+ dictionary costs only $100, however, and many consider it a bargain at that price.)

H19.LIB is a library of H19 control functions for the H/Z19 terminal. It's written in Macro for speed and compactness of code. All functions are here, and other ones are easy to add using the instructions provided. This would allow you to write another one for a different terminal. They are set up to be callable from either FORTRAN or Macro. If you have DEC BASIC and the distribution kit, you can patch them into the BASIC subroutine call list, reassemble BASIC, and be able to call them directly from BASIC, as it is a single object module three blocks long.

BANNER (another Australian entry) is a program that prints out on 132-character wide paper either Roman or Gothic letters for a message that you enter. It is a very nice way to get in good with a lot of the civic groups who like big signs for their events. The characters are dense (overprinted 3 times with "H," "#," and "X") and very precise. It doesn't have much use otherwise, unless you are into signs yourself and want to decorate the place with them.

Along the same line, **LOVE.SAV** prints out Robert Indiana's famous "LOVE" logo with whatever message you wish for the fill-in string. When one is in a bad mood, many unique ideas occur, and strange art results. Don't leave them around where they can be seen, as computer folk are considered strange to begin with, and this could seal your case.

CPM is a program to read CP/M 8" disks to or from RT11 format. You can copy a whole disk or just a file to and from either of them. ASCII format files are exactly interchangeable, so you can enter data on a smaller CP/M system and use it on your H11. I don't know if it could run on the CP/M system if recompiled, but if that interests you, try it. I would think it could be made to work without much effort, unless there is some esoteric reason why not.

SMAC is a Macro library that assists you in writing structured Macro code. It has Macro code to implement LOOP . . . UNTIL . . . , IF . . . THEN . . . ELSE . . . , etc. For those who write in Macro and Pascal, perhaps it's what you need. MACLIB is another library offering somewhat different Macros. They are used in several of the public domain programs for assembly, such as RUNOFF. Several of the preprocessors (FLECS, RATFOR) have string libraries that many like for general FORTRAN use. Many also have subroutines that might be just the thing to speed up or clean up that program you've been writing.

Finally, there are **FLECS** and **RATFOR.** These are both FORTRAN preprocessors that allow "structured" programming methods to be used with FORTRAN IV, a relatively "non-structured" language. RATFOR stands for RATional FORtran, and is very "C"-like, as it was written by the authors of the "C" language. FLECS stands for FORTRAN Logical Extended Control Structures. It is a somewhat easier-to-use preprocessor that makes FORTRAN look very much like Pascal. It has a few restrictions, but it is very helpful. There also exists an old piece of U. S. Navy software called SFT, for Structured FORTRAN Preprocessor. It is by far the best of the lot, as it implements nearly all of the structured forms with very few restrictions. I still have not been able to get all its features working, however, and the manual I have is for its implementation on a different operating system. Someday I hope to get it all together on the RT11 operating system.

And there's hardware, too

On a final note, I would like to mention a few of the unusual, or at least unexpected, hardware items available for the H11. Tapes, disks, etc., are old hat, but what about an Array Processor, callable from FORTRAN? Or high-resolution, full-color graphics with joy stick controls and zoom? Full analog/digital controller subunits capable of controlling a whole factory (or house, or telescope, etc.) unattended? An optical character reader that can read several fonts? (An idea: a word processing service that takes data typed in by part time workers/students/housewives on their own typewriters—only a console terminal is needed, and the whole service/support problem associated with the terminals is gone.)

There are combined controllers for floppy and hard disks, one for hard disk and tape drives, and a floppy controller that will use both 8" and high-capacity 5¼" drives that have the same capacity (approx 1.2 megabytes formatted). One of those small boxes could have a 5¼" floppy RX02 equivalent and a 10-50MB 5¼" Winchester, an 11-23, 256KB, 4 serial ports, and a controller. With one of those new experimental flat CRTs you could have an 11-34A in a briefcase. With an 18 MHz crystal in the '23. . . .

And stuff to read

The H11 opens a lot of doors. Dreaming helps, but don't forget to keep up on your reading. You need to read and keep up with what's available to know what to dream about. *Hardcopy* is a good all-DEC magazine that is coming along. You can get it whether you have a "company" or not, just by calling the circulation desk at 714/632-6924. (Seldin Publishing Company, 187 West Orangethorpe Avenue, Suite 1A, Placentia, CA 92670.)

Most of you probably know about *Buss: The Independent Newsletter of Heath Co. Computers*, but if not, call 202/544-0900 and get a subscription form. It's a nice format newsletter, but if H11 owners don't start writing about their machines, telling about the software they have developed, etc., it will be for the H8 and H/Z89 crowds only. (Buss, 325 Pennsylvania Avenue, S.E., Washington, DC 20003.)

Computers-R-Digital is another all-DEC magazine, a sample of which can be gotten by calling John Runyon at 201/291-1208. *CRDig* is an unusual magazine in its content, as it is in a super-newsletter format, and is usually quite interesting to read. (Directory Database, Box J, Navesink, NJ 07752.)

Mini-Micro Systems is the best of the industrial computer magazines. It keeps you up on what's really new, and what's happening in the field. There are some

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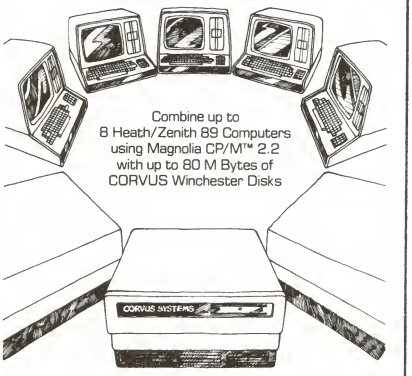

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high-technology articles, but most deal at the integration level. I enjoy it the best of the lot. The only number I have is the main number in Boston — 617/536-7780. You have to "qualify" to get it free, so get your "qualification" form. Put up with it, it's worth it. (Cahners Publishing Company, 221 Columbus Avenue, Boston, MA 02116.)

A catalog of electronic switches, parallel to serial printer line converters, modems, protocol converters, programmable interfaces, all sorts of RS-232 line stuff, junction panels, etc., and other magic is available from Black Box at 412/746-2910. When you are trying to get something to work where it wasn't supposed to, this catalog might help. (Expandor Inc., 400 Sainte Claire Plaza, Pittsburgh, PA 15241.)

If you are not aware of it, DEC has free Software Referral Guides or "Application Interchange Program" guides that list what software is available for each operating system, and these are divided into several separate books. There is one for Commercial, Scientific, Graphics, Educational, and perhaps some others I am not familiar with. They used to be free, but they may cost some money by now. Call your local DEC office and ask for them.

An important note: if you own a DEC central processor unit, you can expect help from the local DEC office. If you get bad service, call the main number in Marlboro (617/897-5111) and ask to talk to someone about it. Amazing things can happen when complaints of this nature reach the main office, so try reason several times before you drop the shoe. Remember that DEC is a huge company and they may not get back to you the same day, but if more than a few days to a week go by, try again. Wait as long as you feel reasonable, then call Marlboro. Keep a note of who you called and when, so you can be specific if they ask. You can also use the DEC LSI Hotline (617/568-5420) and expect the same service as anyone else, but they are understaffed, so it takes a while also. I understand that they have cut back the time they answer problems on the phone to 2 to 5 p.m. Eastern Time. They do call back, really. (Digital

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Equipment Corporation, 146 Main Street, Maynard, MA 01754.)

Getting that public domain software

So, H11 users, there are some useful programs floating around. We sell and support TSX-Plus and its related utilities such as RTSORT and COBOL+, DPS (Documentary Processing System), and others, so if they interest you, get in touch.

As for the public domain software, for $35 a set of ten, I'll copy the set you wish onto your own single-side/single-density 8" floppies (double-density, too). Foreign orders send an additional $15 for the extra hassle and postage required. Send the floppies in their own box inside a small, strong, cardboard box or plastic library case. If it arrives in bad condition, I'll have to refuse it, so wrap it well. Please, no huge boxes. If I were you, I'd check the disks you plan to send me for bad blocks, as I just copy onto them. If there is a bad block or something, you lose a file. Put labels on them if you don't want me to mark them on the factory label. I just put a small number corresponding to the directory listing. I also include a complete listing of what is available, which grows as I copy them off of tapes or whatever onto floppies, along with whatever product information we have at that time.

(Also, let me know if you have some software, to trade or write. At the moment, I am very interested in FORTRAN or Pascal sources for B* and B+ tree implementation as a set of subroutines or procedures. I have some very interesting utilities that might be of interest. Or whatever.)

For a list of public domain programs and other products, send $1 and a self-addressed stamped envelope with 60 cents (40 cents usually does it, but sometimes I have other things to send) postage on it to Fairbrother Associates and I'll send you the listing of what is currently available, along with our current product sheet. (We also have some interesting hardware items besides our controller conversion. A solid state hard disk that's perfect for sorts and as a swapping disk for timesharing, a 256Kbyte memory board that gets cheaper as chip prices go down, timesharing and utility software that work with the H11, and knowledge of good deals on hard disks, printers etc., are available.) And, of course, we're not the only supplier supporting DEC and the H11. Inquire. (Fairbrother Associates, P.O. Box 685, Northampton, MA 01040.)

A look at a product

To show something of what's available to serious H11 users, here are some comments on my pride and joy. (Which, needless to say, is a bit more expensive than the public domain software.)

TSX-Plus is a timesharing operating system from S&H Computer in Nashville, Tennessee. They're the folks who gave us TSX, the first available small timesharing system for RT11 operating system computers. It came out around 1976. TSX-Plus came out in 1980 and it's like two of the most popular such systems for DEC users — RSTS and RSX. In most instances, it runs as fast or faster than RSTS. But it costs only $2,000. RSX costs around $9,000 and RSTS costs around $18,000.

Like both RSX and RSTS, TSX-Plus maps user jobs into extended memory and executes them there. It can use all 256K of memory available with the 18-bit address capability of the 11-23 (or whatever) in a very efficient manner. Real-time or time-critical jobs can be locked into memory and have full access to the I/O page, while other users are timesharing. If libraries are used by many users, they can be made resident and sharable, improving performance of the system. The small overhead it introduces and its simple but efficient time slice algorithm are the secret of its fast response time. It has a protected environment for each user space, spooling, spooling backup, forms support for the spooler, dynamic alteration of constants in the memory swapping algorithm, logon, and system usage accounting. The system shows the user a single-user RT11 environment having a maximum of 56KB workspace, with certain enhancements, mentioned below.

Up to 16 terminals can be locked to certain jobs or devices, so that any non-privileged users cannot peruse the system. Records can be locked to one job or shared. The AR and XD devices described in the public domain software section are very useful here, as they allow a form of private or restricted workspace. Many different terminals are supported; and protocols for many are available which set page size, rubout mode, clear screen if appropriate, Xon-Xoff, etc. Multiplex lines as well as standard serial and parallel lines are supported, along with modems with time-out support. Device directory file caching is used to enhance speed on lookups. TT buffers, data caches, and the performance monitor are stored in extended memory to preserve useable workspace memory. A user can have a full 56KB of workspace without any system code taking up space.

Command files are executed as though they were system commands. No "@" is required. When an input is made, the system first looks on the system disk for an image file of that name, passing the listed parameters, if any. It continues to look, first for a command file on the system disk, then a command file on the storage disk, and finally, an image program on the storage disk. This effectively allows you to extend system commands with your own custom set of operations.

Virtual lines allow a single terminal to control many separate jobs at once, and detached jobs run independent of any terminal. This is the real joy of the system. When I am backing-up or restoring a volume from magtape, I use another workspace just for that job, and go back to whatever I was doing. When the job is over, or needs some input, it beeps the terminal, and I switch back and take care of whatever has to be done, and go back to my job again. Very little lost time. If you work a lot with the '11, you should have TSX-Plus. Also, since the user sees an RT11SJ workspace, no retraining is necessary to use the system. Business users take note!

Several software packages are available to utilize fully the extra features of TSX-Plus, such as record locking, message transmission between terminals, etc. These come from Sandia Labs and other big places which use TSX-Plus. They are well-written and comprehensive, and are one of the benefits of having a good operating system that is widely used.

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The Z100 User's Manual: Clear, Concise, and Useful

Frederick Zimmerman

The Z100 user's manual is a good, professional piece of documentation. There are a few minor flaws in the way some information is presented, but the manual should enable owners to get started with their Z100 computers. And that is a manual's essential purpose.

Sextant received a draft of the manual in mid-July. Therefore, this review should be taken with an extra grain of salt, since the user's manual we are reviewing is not a final copy. Zenith Data Systems may well correct some of the manual's minor flaws in later drafts. But almost all of the following remarks, which deal with the style and content of the manual, should still be applicable.

The user's manual is clearly written and easy to understand. I hope the final version will include credits for the technical writers responsible. The style is simple, and explanations are provided for most technical terms. The manual is never "cutesy," and it only occasionally "hypes" its product.

The format

The table of contents is clean and well-organized, although it is not very detailed. The authors have adopted an annoying "decimal" page-numbering scheme. Pages are numbered by chapter: 1.12, 2.3, etc. Each appendix has its own numbers: A.2, C.4, X.23, etc. What's wrong with numbering pages the straightforward way, from beginning to end: 1 to 200? The decimal numbering scheme is confusing. It is awkward to make cross-references within the manual. It is much more difficult to tell how far page 2.13 is from page 3.4 than it is to tell how far page 23 is from page 37. Perhaps this numbering is just a feature to make revision easier, so that any individual module can be changed without having to renumber the entire manual. Other than that, the only reason to adopt a decimal numbering scheme is to add a "technical" sheen — and that is precisely what Zenith should be seeking to avoid.

The manual is thoroughly illustrated. The drawings are neat and easy to interpret. The text and the drawings are effectively integrated. However, the drawings are poorly captioned: "Pictorial 1-13," for example. That is sufficient if you are going from text to picture. But if you are simply trying to orient yourself in the manual, or wish to consult one picture for an important piece of information, a caption saying "Structure of a Floppy Disk" would be very helpful.

The text breaks the keyboard into four groups: alphabetic, nonalphabetic, numeric entry, and "other" keys. A drawing shows each group. Then the text discusses the special functions of each key within the group: the CAPS LOCK key, for example.

The Z100 user's manual is divided into three sections: "Operation," "Disk Operating System," and "Computer Programming and BASIC." Thirteen appendices are attached. Each section has its own introduction and index. There is a master index. Each section is divided into three to seven topics such as "Diskettes," "Loading ZDOS," and "Programming Languages."

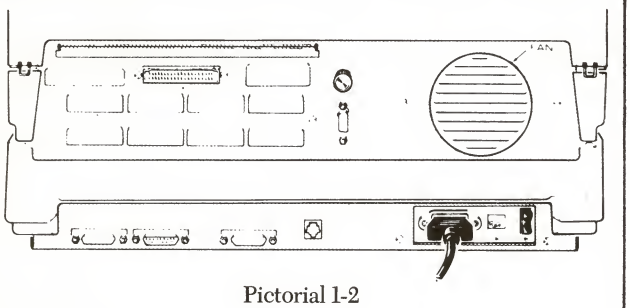
If Zenith is trying to give users a sense that the computer is a practical, easy-to-use business tool, this reverent capitalization seems somewhat counterproductive.

The content

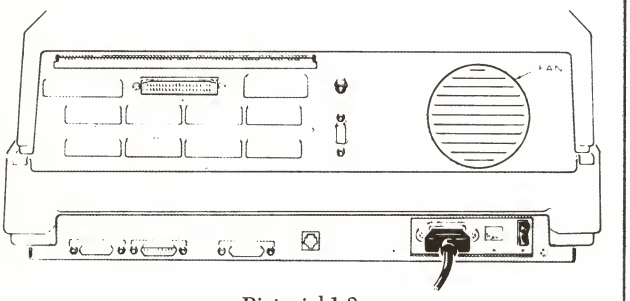
Section 1, "Operation," begins with the topic of "Your Computer System." There is a brief description of the computer's functions, which emphasizes business applications. "Your new Desktop Computer is a tool, much like a typewriter or a calculator." (Incidentally, the manual consistently capitalizes the word "Computer," even when it stands alone. If Zenith is trying to give users a sense that the computer is a practical, easy-to-use business tool, this reverent capitalization seems somewhat counterproductive.) The next part of the manual describes the hardware of the all-in-one — video display, keyboard, disk drives — and some of the peripherals which may be attached — printer and modem, for example.

Next the manual tells you how to set up the computer. It tells you where to locate the machine, and what conditions to maintain in its environment. Then several pictorials are provided to show users what

each of the plugs on the back of the computer does. (These pictorials are labelled 1-2 and 1-3, and there is no way to distinguish between them other than in the text, which tells us that 1-2 is the all-in-one model,



Pictorial 1-2



Pictorial 1-3

and 1-3 is the low-profile model.) There is a checklist showing the proper steps to connect the power to the computer.

The manual then describes the functions of the various keys on the keyboard. Noteworthy features include "typamatic" automatic repeat on all keys, at 11 characters per second, and a "Fast Repeat" key for 28 characters per second. There are also twelve numbered function keys and a numeric entry pad.

The manual moves on to disk drives and tells you which is Drive A and which is Drive B. There is a helpful explanation of the structure and design of floppy disks. The manual also tells you how to load and take care of your diskettes.

And, at last, the manual shows you how to power-up your computer. Now you learn about a colorful feature which is a unique result of the Z100 series' high-resolution graphics: the "hand prompt," which points to the cursor. It looks like one of those old-fashioned pointing hands that you see in printed material.

The manual takes you step-by-step through the process of loading the Z100 Customer Demonstration Diskette. After that is completed, Section 1 ends with several pages of trouble-shooting and service information. I found this a strange point at which to end a section entitled "Operation," since loading the Customer Demonstration Diskette enables the user to do nothing more than run a business graphics program. Most users will want to skip the index at the end of Section 1 and proceed directly to Section 2, "Disk Operating System," where the user will actually learn how to make the computer operate.

Section 2 continues with an explanation of the

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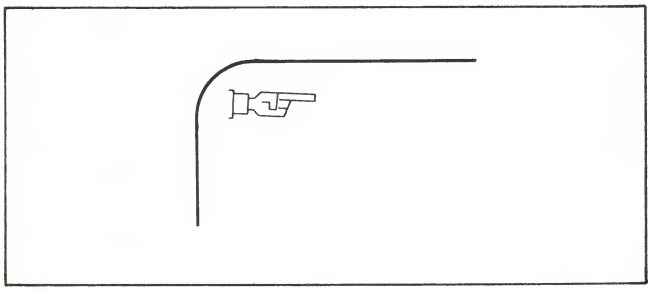
functions of disk operating systems and monitor programs. Then you are shown how to boot the Zenith Disk Operating System (ZDOS). The distribution diskettes include an automatic backup procedure, which is carefully explained. The manual then explains the various commands and key functions which ZDOS will recognize. You are given several examples of how to create, manipulate, and maintain files. There is an index at the end of the section.



Z100 high-resolution graphics permit the inclusion of a "hand prompt".

Section 3, "Computer Programming and BASIC," is "optional reading." It is a brief introduction to some important concepts of programming, aimed at the user who has little prior programming experience. There is a useful discussion of programming languages, which explains the differences between machine languages, assembly languages, and the several types of high-level languages—compilers, interpreters, and pseudo-compilers — with a helpful chart. Section 3 also includes topics such as "Understanding BASIC" and "Programming in BASIC," which explain how to use BASIC, the standard programming language for microcomputers. "Designing a Program" shows you, in detail, how to write an elementary business application program. The manual also tells you how to load Zenith's version of BASIC, ZBASIC, and how to save programs written in BASIC. The manual explains the distribution between the direct (command) mode of BASIC and its indirect (line-numbering) mode. In short, Section 3 familiarizes the novice with several important aspects of BASIC, and does so in a clean, succinct manner.

The appendices

There are thirteen appendices, which are just as useful, in many ways, as the manual itself. Appendix A is a glossary of commonly used computer terms. It is sufficiently large, considering the space limitations involved. The glossary contains ten out of twelve technical words picked from the first six paragraphs of a randomly chosen article in *Sextant*. Though the omissions are fairly significant words — "microprocessor" and "source code"—I do not recall seeing those words in the manual itself.

Appendix B includes a chart which converts decimal code to octal code to hexadecimal code to ASCII characters; a chart which lists the hex codes the keyboard sends when keys are pressed; and a chart showing the various escape key functions. Appendices C and D provide full summaries of ZDOS and

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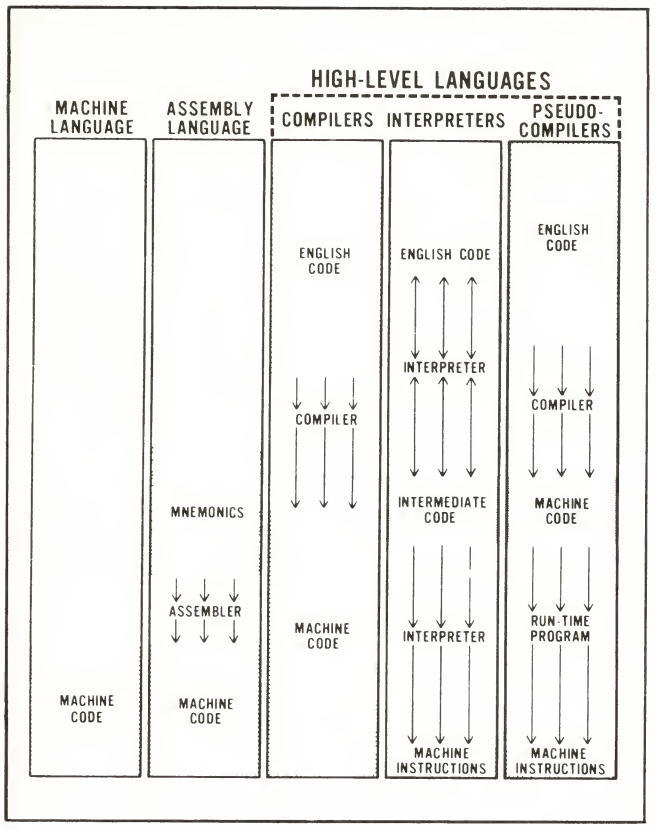
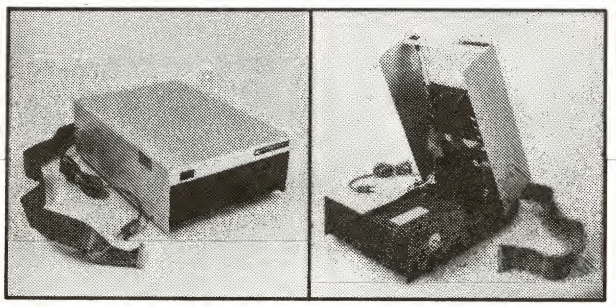


Section 3 of the manual includes an explanation of the differences between machine languages, assembly languages, and the various high-level languages.



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CIRCLE #318 ON READER SERVICE CARD

ZBASIC, with each command explained in a sentence or two. This is a very useful feature indeed.

Appendix E lists the system's specifications. Appendix F shows, in detail, the procedure for configuring the computer to use each of the various compatible printers. Appendix G gives a few highlights of the CP/M-85 Disk Operating System, which can be used with the Z100 series instead of ZDOS. Appendix H includes procedures and checklists for the Z100 series owners who want to use their old H/Z89 software on the new computer. Appendix I shows how to reconfigure some features of the Z100 internal hardware.

Appendix H includes procedures and checklists for the Z100 series owners who want to use their old H/Z89 software on the new computer.

Appendix K shows three methods to make backup copies of diskettes.

Finally, Appendix J shows how to use the Interactive Business Graphics Program which is part of the Customer Documentation Diskette. This menu-driven program can be used to adapt vertical bar graphs, single pie charts, horizontal bar charts, point-to-point line charts, trend-line analysis charts, and three-dimensional bar charts to display business data for the user. Zenith appears to be very proud of this business graphics package, which benefits significantly from the high-resolution graphics capabilities of the Z100 series. *

The Z100 user's manual is well written and thorough. A few minor flaws mar the manual's presentation of information, but the flaws are easily corrected, and I hope that Zenith will do so in a future revision. All in all, the user's manual is a useful tool for understanding the Z100 series computers. Its high quality is a good omen for the Zenith user's community.

Z100 Prices Announced

On June 29th, Zenith Data Systems announced the prices of its new Z100 series computers described in *Buss* #51. The news came during a luncheon in the fifth floor ballroom of Atlantic City's Playboy Hotel. The event was well attended by reporters covering Comdex/Spring '82, designed to bring together "thousands of Independent Sales Organizations" with "more than 450 leading computer industry vendors."

In a change from earlier plans, Z100 series software will be priced separately from the hardware —a move aimed at making the computer prices more easily comparable with those of other vendors who

price software separately.

The all-in-one ZF120-22 with two 5.25" disk drives (320K each) carries a suggested retail price of $4,099. The low-profile ZF110-22 with two drives and video RAM to support color graphics has been priced at $3,999. A new configuration, the ZF100-21, combines a single drive with video RAM to support monochrome graphics in a low-profile case. Its list price will be $3,249. Users of either low-profile configuration will also need a video monitor in the $100 to $1,000 range.

A set of nine RAM chips to boost program memory from 128K to 192K has been priced at $180, while the chips to convert monochrome graphics to color video support will cost $320 at the suggested retail price.

A $500 software package for the Z100 series includes Microsoft's Multiplan spreadsheet ($250), as well as CP/M-85 ($150), the Z-DOS variation of MS-DOS ($150), and a version of BASIC for each of the two operating systems ($175 each). The individual prices total $900.

Delivery of the initial three Z100 series models is set to begin in September, with a kit version of the all-in-one due from Heath Company "in early 1983." The latter will include the technical manual which is expected to be ready in November or December at a price well under $50.

Reprinted from *Buss: The Independent Newsletter of Heath Co. Computers*, issue of July 6, 1982.

Sextant's Premiere issue is still available—

Your collection of Heath/Zenith information will be incomplete without the Premiere issue of *Sextant*, the independent Heath/Zenith magazine. A limited number of copies of the Spring 1982 issue are still available, but you need to act now.

Here's what Issue #1 has to offer you:

Heath/Zenith Computers: An Interview and Overview
John Walker and David Johnstone

Growth seems to be the keynote of the Heath/Zenith marketplace these days. We give you here some of the dollars and cents of that growth with an interview and evaluation of what makes this microcomputer marketplace different from the others.

A Professional Writer Looks at Budget Word Processing
Hugh Kenner

With an Introduction by William F. Buckley, Jr.

Hugh Kenner explains how he uses a $65 word processing package to produce magazine articles for *The New York Times Book Review, Harper's,* and *National Review.*

How to Turn Zenith Screen Graphics into Color Slides
F.X. "Skip" Millor

Colorful graphics for business meetings and training sessions can be produced with your Zenith computer and a little imagination.

Benton Harbor BASIC Tests Typing Reaction Time
Raymond Dotson

If you want to increase your typing speed and maybe make a game out of it, too, this program is made to order.

Disk Programming *Without* HDOS
Richard E. Smith

There will be times and purposes when programmers will want to do without their computer's operating system and do it all themselves. So how is it done? Easily!

Print Spoolers: A Background and Reviews of Six Software Products to Break Your Printer Bottleneck
Kenneth A. Patrick

As your system or your demands grow more complex, you may not like having your computer sitting around doing nothing until your printer has finished tapping out already processed data. Spooling is the software to take care of that. Here we give a brief history of spoolers and reviews of six spoolers of interest to the Heath/Zenith user.

Rubik's Cube: A Computer Simulation in Microsoft BASIC
Arthur A. Frost

A Candid Look at Tiny Pascal
Arnold R. Madeira

Pascal is a great language for learning good programming skills. It costs $325. Its little brother, Tiny Pascal, may be more in line with your budget.

A Parallel Interface for the '89
J.C. Hassall

Want to add a parallel port to your H/Z89, or simply get an inside view of how the computer handles input and output of information?

What's a Company Like Zenith Doing in the Computer Business?
Jerry K. Pearlman

Jerry K. Pearlman is the Zenith Radio Corporation executive responsible for their computer business. These remarks are the best thing we've seen so far to explain how Zenith views their role in the microcomputer market.

To get the Premiere issue of *Sextant*, send $2.95 to the address below. If you have yet to subscribe, fill out the subscription card provided in this issue and drop it in the mail today. Check the box that indicates you'd like to include the Spring issue in your subscription.

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Supplier Notes

SOFTWARE TOOLWORKS AUTOMATES DISK PRODUCTION

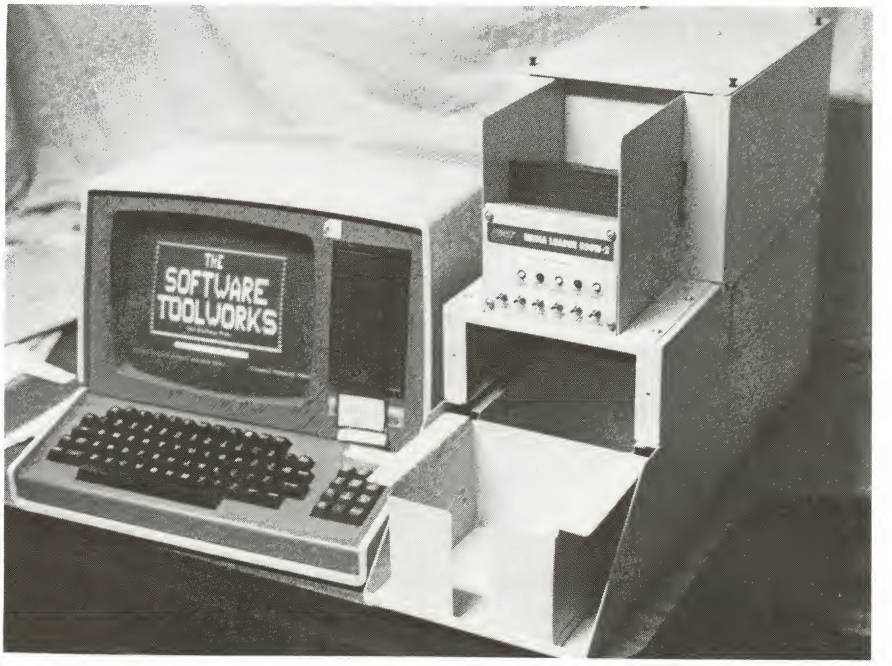
The acquisition of automatic disk loading equipment this month made the Software Toolworks the first vendor of primarily Heath/Zenith software to automate their production of program diskettes.

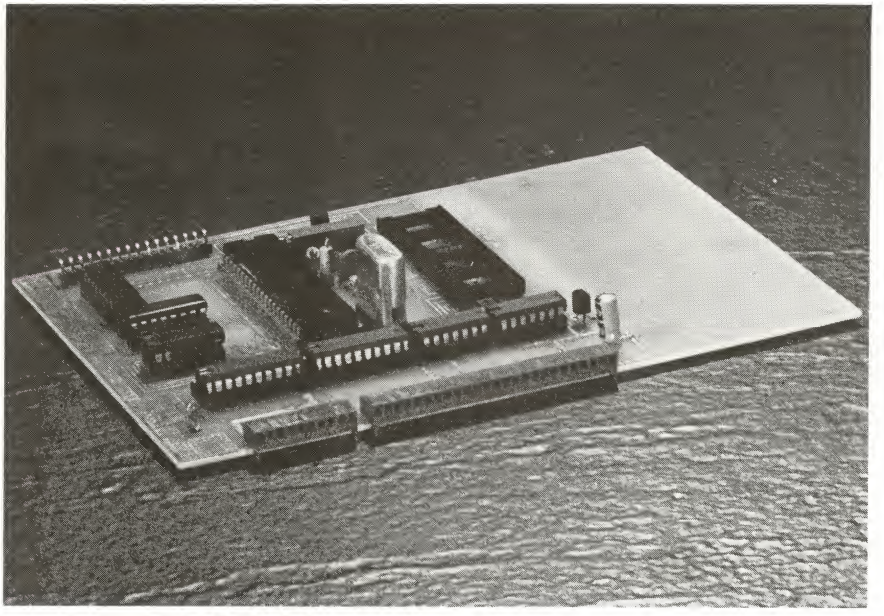
The automatic loader consists of a disk drive with a feed mechanism for inserting disks from a hopper and removing them into one of two bins. It is connected to an H89 computer, to which it appears as a normal 5¼" disk drive. This allows the use of modified versions of standard disk duplication software, and permits copying all disk formats which the H89 supports. Loading and unloading of disks are controlled by the computer through a serial interface. The loader is manufactured by Media Systems Technology of Irvine, CA.

According to proprietor Walt Bilofsky, The Software Toolworks is the first Heath/Zenith vendor to progress beyond copying disks manually. "As far as I know, even Heath, where I'm told they copy up to 100,000 disks a month, still puts the disks into the drives by hand," he said.

Bilofsky contended the equipment was necessary to enable the Toolworks to maintain its quality standards and low prices in the face of increasing volume. "It means our staff — Susan, Leonard and myself — will be able to devote more of our time to customer service and software development," he said. "We could have hired another person just to copy disks. But expansion means more time spent in administration, and we prefer to remain small, efficient and responsive."

Leonard is Susan's H89 computer, and is in charge of invoicing and disk duplication. The new equipment allows him to copy disks with minimal supervision.





EIGHT CHANNEL DIGITAL VOLT METER BOARD

This eight channel Digital Volt Meter (DVM) Board plugs into any Heath/Zenith H/Z89 computer, allowing data acquisition, display, and high level computations, as well as control functions defined by the user. Any or all eight input channels can be accessed under software control. The 12 bit DVM accepts DC voltages from 0 to ±4 volts with 1 millivolt accuracy and drift of less than 1 uv/C. A 20 PPM variable reference supply on the card allows user programming to set the full scale readout values of the DVM. Features of the card allow interfacing to sensors to measure pH, pressure, flow rates, temperence, etc. Computer calculations may be done under user control, with the results displayed on the video terminal, printed, or stored on disk for future evaluation. Board versatility includes provisions for plug-in modules to be installed onboard to further enhance its capabilities. Inquiries regarding the board and plug-in accessories welcomed.

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Haven't I Seen You Some Place Before?

That small computer Computerland wants to introduce us to sure looks like a Z89. Strange, since most of their stores don't carry it. Maybe the three-piece systems they *are* selling wouldn't look as good in an ad. And two people would look rather silly huddled around one of their portables. Wonder how many people come in and ask to see the computer in the picture?

Changing Times doesn't sell computers. One thing they *are* selling is exposure to 5,600,000 readers who want "a change for the better." Their idea of a change for the better won't cause any dispute with most Heath/Zenith users.

Interstate Electronics Corporation *is* selling a specific product. One with their name on it. But it wouldn't be surprising if they got some of the components from a supplier we all deal with too.

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From household budgeting to home computing
Family budgeting used to be a matter of guesstimating your expenses and praying you could stick to them. Now, home computers have made a science out of it.
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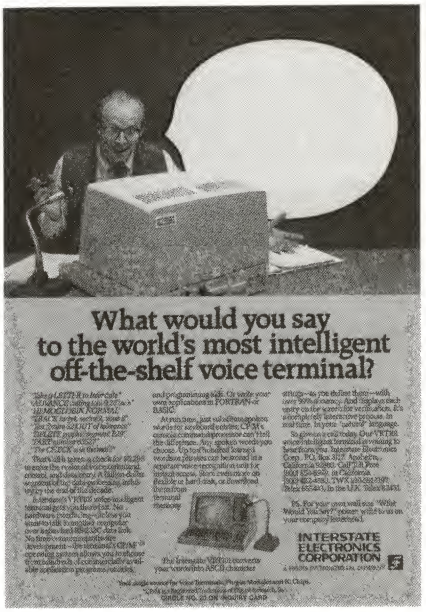
*Source: MRI Spring 1981



Classified Ads

To get in touch with your fellow Heath/Zenith users, place your short notice in *Sextant*'s classified section. The rate is only 75¢ per word with a minimum of 15 words. Send your typewritten ad and payment to: *Sextant*, Classified Advertising Department, 716 E St. SE, Washington, DC 20003. (Please include your name and telephone number for our records.) We need to receive ads for the Winter issue by October 22, 1982. If you have any questions, contact Sharon Conaway at 202/544-2868.

DIABLO RIBBONS & PRINTWHEELS Sextant Readers Special: Diablo Universal BlackMulti-strike ribbons #8R1077. For all Diablo printers. Yield 360,000 characters! $75 per 12 or $39 per 6. Add $2 shipping and handling. MI residents add 4% sales tax. Write or call for price list and product information. All products sold with money-back guarantee. Business Support Services, Inc., 705 Butternut Ave., Royal Oak, MI 48073, 313/585-4736.

INTEGRATED SOFTWARE Series of seven business software accounting packages, General Ledger, Account Receivable/Order Entry, Account Payable/Purchase Order System, Inventory, Payroll, Fixed Assets Accounting, Mailing List. Fully documented with source code supplied on 8" disk for $300. Requires 48K, CP/M, C-Basic-2. Information write Micro Access Systems, P.O. Box 304, Bingham Lake, MN 56118.

MICRO MEDIA MAGAZINE, a floppy Disk-Based Publication for the H19, H89, or Z89. For more information and a "FREE" Software Catalog write Micro Media Magazine, Dept. SE, P.O. Box 402286, Garland, TX 75040.

HDOS SOFTWARE, STATPK (menu-driven statistical analysis package) $20; GAMES-1 (Hangman, LIFE, others) $15. Other disks available. QUICKSILVER Data, Box 132, Knob Noster, MO 65336.

FORTRAN support for HDOS: overlay, 9511 arithmetic, graphics, address sort, and console input subroutine libraries. MICROTRAN, 76 Flintwell Way, San Jose, CA 95138.

AUTHORS:
Help *Sextant* become an even more valuable tool for your fellow Heath®/Zenith computer enthusiasts by contributing an article for publication. We're looking for human-interest stories, in-depth technical features, program descriptions, product reviews and tutorials which relate specifically to Heathkit® and Zenith systems.

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Luminaries

Ray Albrektson graduated in Physics from Duke University and worked with long-range radar in the Air Force. He may find it necessary to get his '89 to work while he's asleep, since he keeps busy himself offering character generator software for learning Greek, as well as providing the clock board mentioned in his article, as well as going to school as a graduate student at the International School of Theology in San Bernardino, California.

Don Carter, as he notes in his article, has a marine engineering company, located in Florida. Besides showing how a small businessman can jump into computers with both feet, he has chosen an occupation which seems singularly appropriate for an author submitting an article to a magazine named *Sextant*.

William Garner manages the computer aided design and computer aided manufacturing (CAD/CAM) of the large external tank of the space shuttle. He was also involved with the Viking project Mars lander. So what Bill does with his H8 at home could be described as a *Buss*man's holiday.

Hal Glatzer is a writer and editor in the computer field. He also has a personal interest in how well companies like Magnolia support Heath/Zenith computers since he's a customer as well as a reporter. His second book on computers is *How to Use: Zenith/Heath Computers*, published by S-A Design.

Ed Judge prides himself on the fact that Fairbrother Associates appears to be the only company devoted exclusively to the support and improvement of the H11 computer. Ed has more than an economic interest in the subject since he's a disabled veteran who has been using computers (H11, DEC, and non-DEC) in his rehabilitation. He plans to return to school to major in Computer Science.

Hugh Kenner takes word processing seriously since he uses it to turn out a lot more than just personal correspondence. "On the groggy morning after," he wrote us that he had sent to Knopf "the typescript of *A Colder Eye*, a book on the modern Irish writers, 572 pages typed using TEXT 4.0 and a *single* print command. The Diablo ran nearly 7 hours. At one point or another I must have used every capability of TEXT. Everything performed flawlessly."

Rick Lutowski's company, Microtran, specializes in FORTRAN. The FORTRAN-callable ADSORT is one example. He's also employed as a naval architect — so *Sextant* has another nautical reference in this issue.

John Mays is a retired Marine Corps officer employed as an operations research analyst in the aerospace industry. At work he is concerned with computer modeling and simulation. He moonlights as Stuart (his middle name) Software which offers a program for the I Ching, the Chinese book of changes (a connection with artificial intelligence?).

Graphics on Your H8

William R. Garner, Jr.

Most people do not select the small Heath/Zenith computers because of their graphics capabilities. Some other computers are ahead in standard form. While some very impressive things have been done with the H19 graphics set, what is often needed is the ability to address each dot on the display. This is just not available from Heath. There is a $600 (recently reduced from $900) black and white modification to the H19 terminal, but it still does not have color such as is found on far less expensive systems.

On the other hand, those computers are generally far less suited for program development than the Heath/Zenith systems. The H19 has an 80 column screen and sharp, clear characters. Both the HDOS and CP/M operating systems are available along with powerful program development tools like PIE and Pascal MT+. The HA-8-3 color graphics board for the H8 computer offers the ability to address dots on an accessory display, such as a color monitor or a television via a video tape recorder. A similar color board is now available for the H89 computer from New Orleans General Data Services. That is the same company that made the HA-8-3 color board. My company, Far Field Software, uses such a system to develop programs for general graphics, to display models of molecules, and to do some simple computer aided design.

These color boards provide a display of 256 individually addressable dots across the screen by 192 dots down. Whether each dot is turned on or off is determined by the value of individual bits in the first 6144 bytes (256 x 192/8 bits per byte) of memory on an extra 16K of RAM on the color board. This type of display is referred to as a bit-mapped screen.

Materials

Adding substantial graphics capability is moderately expensive, but the results are worth it. The cost of a color board is about $400, as is a new color monitor. In addition, we use Pascal MT+ ($350) for the programs, which requires 56K RAM. We consider 500K of disk storage (a standard drive plus a Tandon) to be a workable minimum for large programs. Also, running at 4 MHz is an asset for both compiling and executing graphics programs because everything goes at twice the speed of a standard system. It takes approximately four minutes to compile a 550 line program with Pascal at 4 MHz.

After the programs are ready, the extra disk space is no longer needed; however, in some cases the programs take a relatively long time to run. The 4 MHz modification helps here too. Another item that helps draw complicated displays faster is an AMD9511 arithmetic processor chip (APU). Many real-life programs run about twice as fast using the APU. It is an option on both the color boards mentioned above.

For graphics hardcopy, the contents of the memory on the color board can be sent to a printer such as the Epson MX-80 with Graftrax. We have also written a program to dump the video memory to a Diablo daisywheel printer, and the color monitor display can also be photographed. These capabilities are in addition to the Tektronix 4662 plotter used with different programs for larger scale drawings.

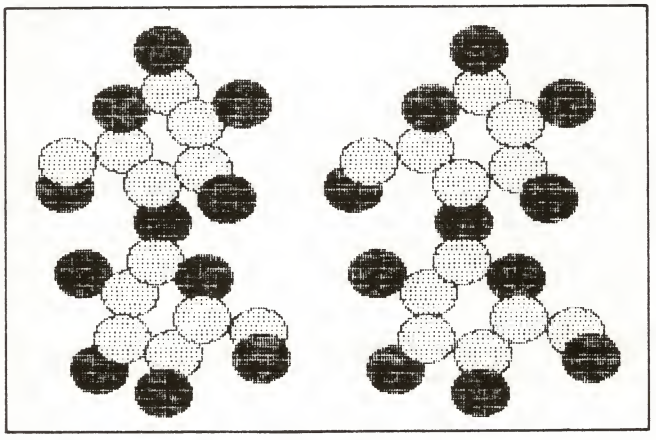


Figure 1.

Table 1 lists the present hardware/software configuration. In addition, Microsoft FORTRAN and MBASIC are used to generate input data for the Pascal Molecular Drawing Program and MBASIC is used to run the Tektronix plotter.

Methods

The basic idea for making drawings is that a pen, either real or imaginary, is moved around the work area. The functions MOVEPEN(X,Y) and PLOTPEN(X,Y) are "primitives" that tell the pen to proceed to a point with x and y coordinates. If MOVEPEN is called, no line is drawn, while if PLOTPEN is called, a line is drawn from the pen's starting location to the one specified by the values of X and Y. On a color display screen or a printer, dots along the line would be activated when PLOTPEN is called. On the Tektronix plotter, the pen is kept down on the paper by PLOTPEN and up off the paper by MOVEPEN.

Many other primitives are needed to run the color graphics system, such as to set the background color

Hardware
H8 Computer with
D-G Z80 CPU board at 4 MHz
D-G 64K RAM board
Heath HA-8-3 Color Graphics Board
with AMD9511 Arithmetic Processor Chip
H17 disk drive unit with
Tandon 96 TPI double-sided, double-density at 400K
One or two standard 100K drives
Epson MX-80 printer with Graftrax and 2K serial board
Diablo 630 printer
Zenith color monitor
H19 terminal
Tektronix 4662 Plotter/Digitizer
(required if MX-80 plot mode quality not adequate)

Software
HDOS 2.0 and CP/M
Pascal MT+
PIE (Software Toolworks, for creation of the source code and data sets)
Far Field Software's Color Graphics Package
DKH17V2.DVD (Ultimeth, for HDOS)
or BIOS-80 (Livingston Logic Labs, for CP/M 2.2)
(to allow use of the 400K drive and systems running at 2 or 4 MHz)
Lindley printer driver
(not required for CP/M 2.2)
DI.DVD (for the Diablo under HDOS)

Table 1.

or to erase a portion of the screen. Once these primitives are available, larger procedures can easily be written to form objects such as circles. Two-dimensional objects can also be shaded with varying intensities of several colors. A library of these procedures such as the Far Field Graphics Library or the Lucidata Graphics Addition can be built up and included when the program is compiled and linked. The programmer would then only need to know that the routines exist and what parameters must be passed to them.

The Far Field Software Color Graphics Package consists of a Pascal MT+ linking library of primitive procedures that control and monitor the TI9918A graphics chip on these color boards. The library initializes, sets options, writes to or reads from the bit-mapped video memory, creates and moves sprites (dynamic animation objects), paints color, and sets or resets the bits that define the picture sent to the video monitor. Also included are sample programs that demonstrate procedures contained in the linking library and some useful programs that letter the screen and drive the Epson or Diablo printers. Documentation is minimal, but so is the price, and Pascal is rather self-documenting, anyway.

Pascal is an ideal language for programming a color graphics package. Pascal MT+, being a native code compiler, has the speed needed for this type of work. Besides the modular nature of Pascal, the ability to declare new variable types is very useful, as is the wide range of logical control structures.

Using the Graphics Library, it is a simple task to write a program that simply draws a line on the screen. One first creates a Pascal MT+ program with an editor, as shown in Listing 1. The editor file is saved on the disk and the Pascal compiler called. After compilation, the program is linked to the Graphics Library and the standard Pascal library.

Drawing a segment of a polymer molecule is still simple. The main program is composed of the statements presented in Listing 2.

The reader who is not familiar with Pascal may be puzzled by some of the syntax. Subroutines in Pascal are called by name, such as INITIALIZE and DRAW CIRCLE. RADIUS: = 11 is read as "radius is assigned the value 11." The CASE statement is a kind of multiple IF statement. It is read as "If the atom type is carbon, then the radius is 10, the color is black, and it is half-shaded; or if the atom type is oxygen, then the radius is 11. . ." etc. Three non-standard types of variable are used: type of atom, color, and shade.

By any standard, the above program represents a lot of power using very few commands. The program PRINTIT, supplied as part of the Graphics Library, examines the memory on the color board and prints the

```
PROGRAM LINE
    TYPE: COLOR (BLUE, YELLOW);
    BEGIN
        INITHIGHRES (BLUE, YELLOW)   {this sets the line to blue and the back-
                                      ground to yellow}
        MOVEPEN (50, 100);           {this moves the graphics cursor to raster
                                      x=50, y=100 without plotting}
        PLOTPEN (100, 200);          {this plots a line from x=50, y=100 to
                                      x=100, y=200}
    END.
```

Listing 1.

images on an MX-80. A drawing, with two images rotated so that it is stereographic, is shown in Figure 1.

The stereo image is built in three steps. First, the molecule is drawn in the center of the screen. That is done with the above program. Using some additional loop structure to permit interaction with MOVE, the molecule is rotated and translated to the position desired by the user on the left side of the screen. Third, an exact copy of the molecule is translated to the right side of the screen and rotated eight degrees to produce the stereo pair.

Computer aided design (CAD) is accomplished by instructing the computer to draw shapes such as arcs, triangles, or rectangles at points chosen by the user. This can be accomplished by entering the x, y, z coordinates manually or by the position of a cross hair moved by a joystick. These segments form a two-dimensional object; however, Far Field Software is currently developing a three-dimensional data base for its CADF program. The model can be seen from any position and at any magnification, similar to the Molecular Drawing program. The bell crank, cam, and base plate shown were designed using the Far Field CADF program.

The main limit of the Heath color graphics system is the number of individual points that can be displayed. For some projects, a 1024 by 1024 raster or a storage tube display is needed, instead of the 256 by 192 raster display used on the Heath and many other microcomputers. A second limitation of the chip is that the individual colors can only be called with lower resolution. If colors are solid, there is undesired overlap of colors in high-resolution mode. This problem is lessened by using half-shading, and eliminated if only two-color drawings are used. Two-color drawings are often sufficient, because half-shading gives a total of three classes of objects: shaded, half-shaded, and unshaded.

Graphics on the Heathkit computers are under intensive development, and there is no easy way to predict the extent of meaningful accomplishment resulting from their use. The speed of drawing is now satisfactory, even when programming in a high level language, and the tools for graphics are now available.

Suppliers of some of the hardware and software listed in Table 1 may be reached at the following addresses:

D-G Electronic Developments Co.
700 S. Armstrong
Denison, TX 75020
214/465-7805

Far Field Software
1031 Rue Verand
Slidell, LA 70458
504/641-3741

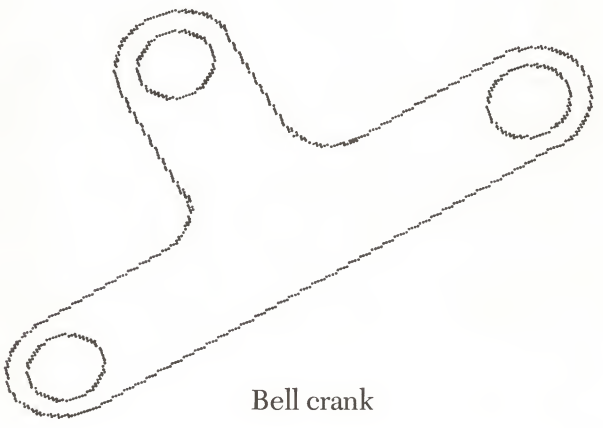
Lindley Systems
21 Hancock St.
Bedford, MA 01730
617/275-6821

Livingston Logic Labs
P.O. Box 5334
Pasadena, CA 91107
213/792-4763

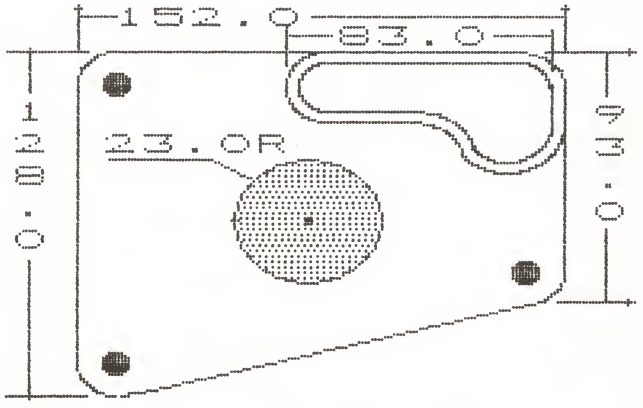
New Orleans General Data Services
7230 Chadbourne Dr.
New Orleans, LA 70126
504/241-9495

Software Toolworks
14778 Glorietta Dr.
Sherman Oaks, CA 91423
213/986-4885

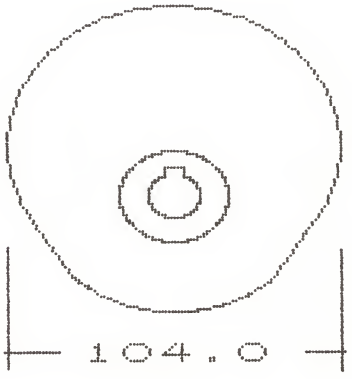
UltiMeth Corp.
24025 Fernlake Dr.
Harbor City, CA 90710
213/539-4276



Bell crank



Base plate



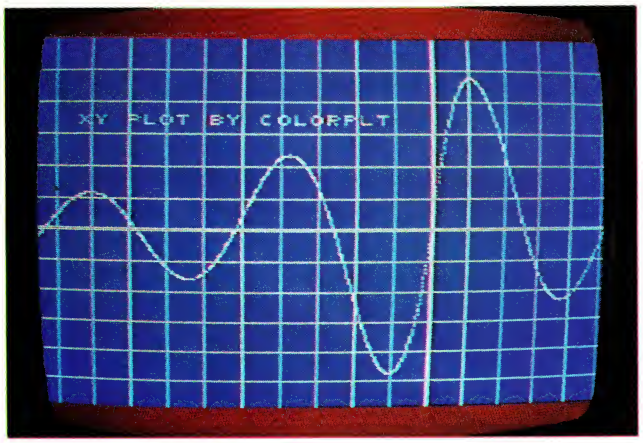
Cam

```
BEGIN
INITIALIZE; {Procedure INITIALIZE clears the 16K of RAM on the color board and
    determines the color of the background.}
GETXYZ; {Reads a disk file that contains the X, Y, and Z coordinates of the center of each
    atom.
    Also read in is a string, ATOMTYPE, for each atom. The number of atoms (NATOMS)
    before the end of file is also returned by GETXYZ.}
MOVE; {The molecule is rotated, translated, and zoomed in or out an optional amount
    by this procedure.}
SORT; {It is necessary to draw the most distant atoms first. The closer atoms are then
    drawn by first erasing the area where they will go and then drawing the desired atom
    with shading. SORT makes an array of atoms with the most distant ones first.}
  FOR INDEX:=1 TO NATOMS DO
    BEGIN
      CASE ATOMTYPE OF
        CARBON:  BEGIN
                 RADIUS:=10;
                 COLOR:=BLACK;
                 SHADE:=HALF;
                 END;
        OXYGEN:  BEGIN
                 RADIUS:=11;
                 COLOR:=RED;
                 SHADE:=HALF;
                 END;
      END;
    DRAW CIRCLE (X[INDEX], Y[INDEX], RADIUS, COLOR, SHADE);
    END;
```

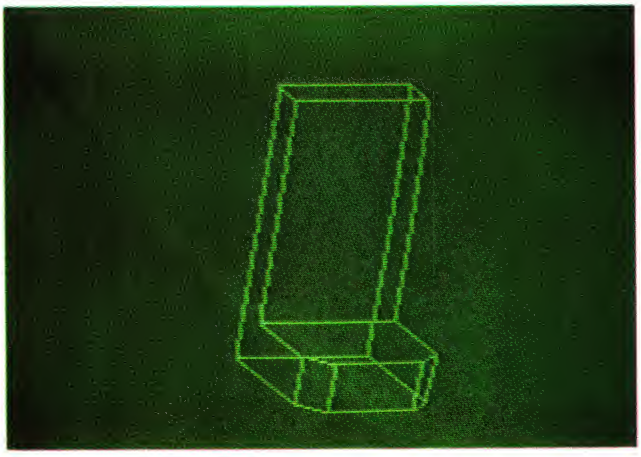
Listing 2.

Acknowledgement

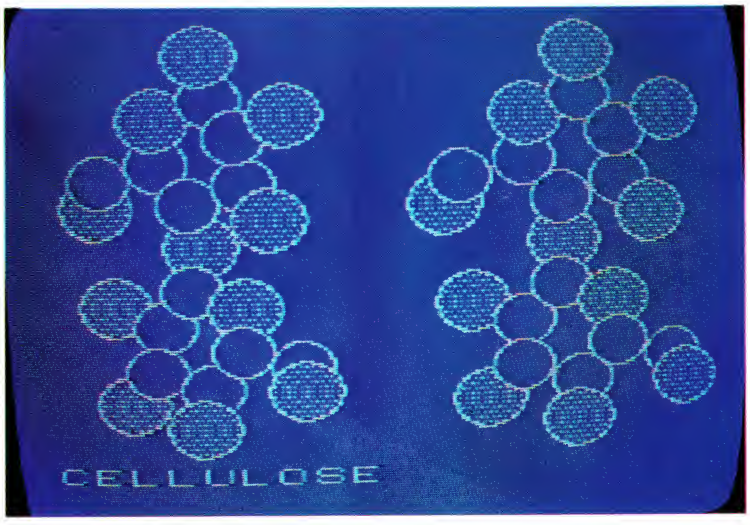
The molecular drawing program was written in collaboration with Dr. Al French, who also supplied the atomic coordinates for the molecular segment of cellulose.



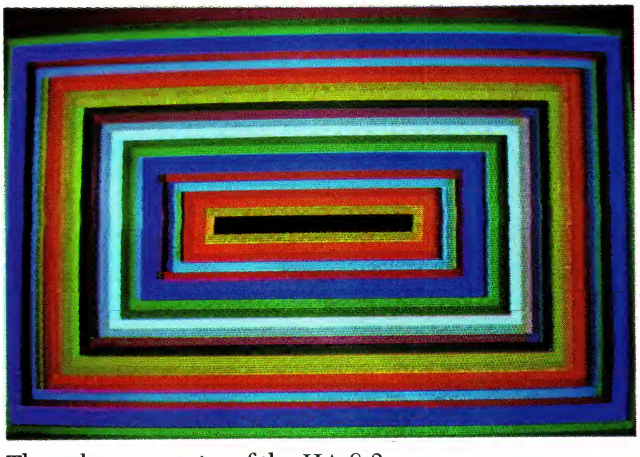
Heath Company's HA-8-3 Color Graphics Board can produce color plots such as this.



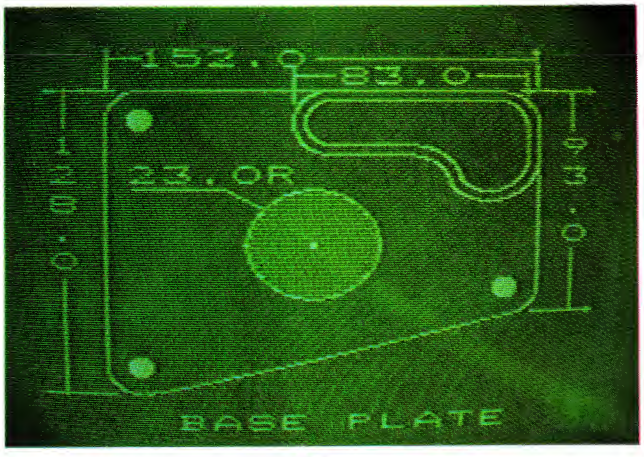
Computer aided design (CAD) may be applied to development of components such as this bracket.



This product of Far Field Software's Molecular Drawing Program produces a three-dimensional image for those who can cross (and uncross!) their eyes at will.



The color repertoire of the HA-8-3.



A product of the program Computer Aided Design Far Field (CADF).

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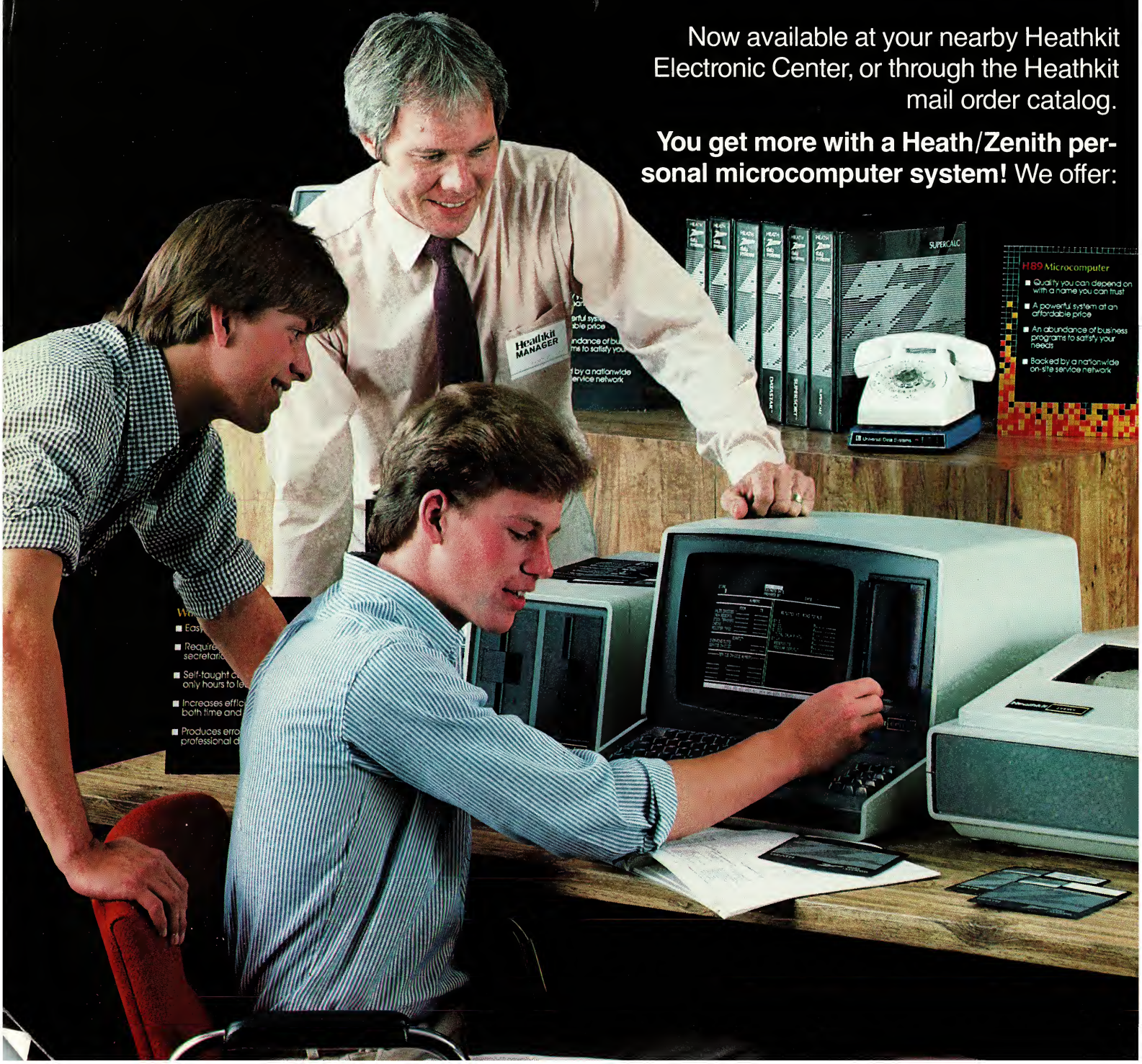
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